S·A·E Journal

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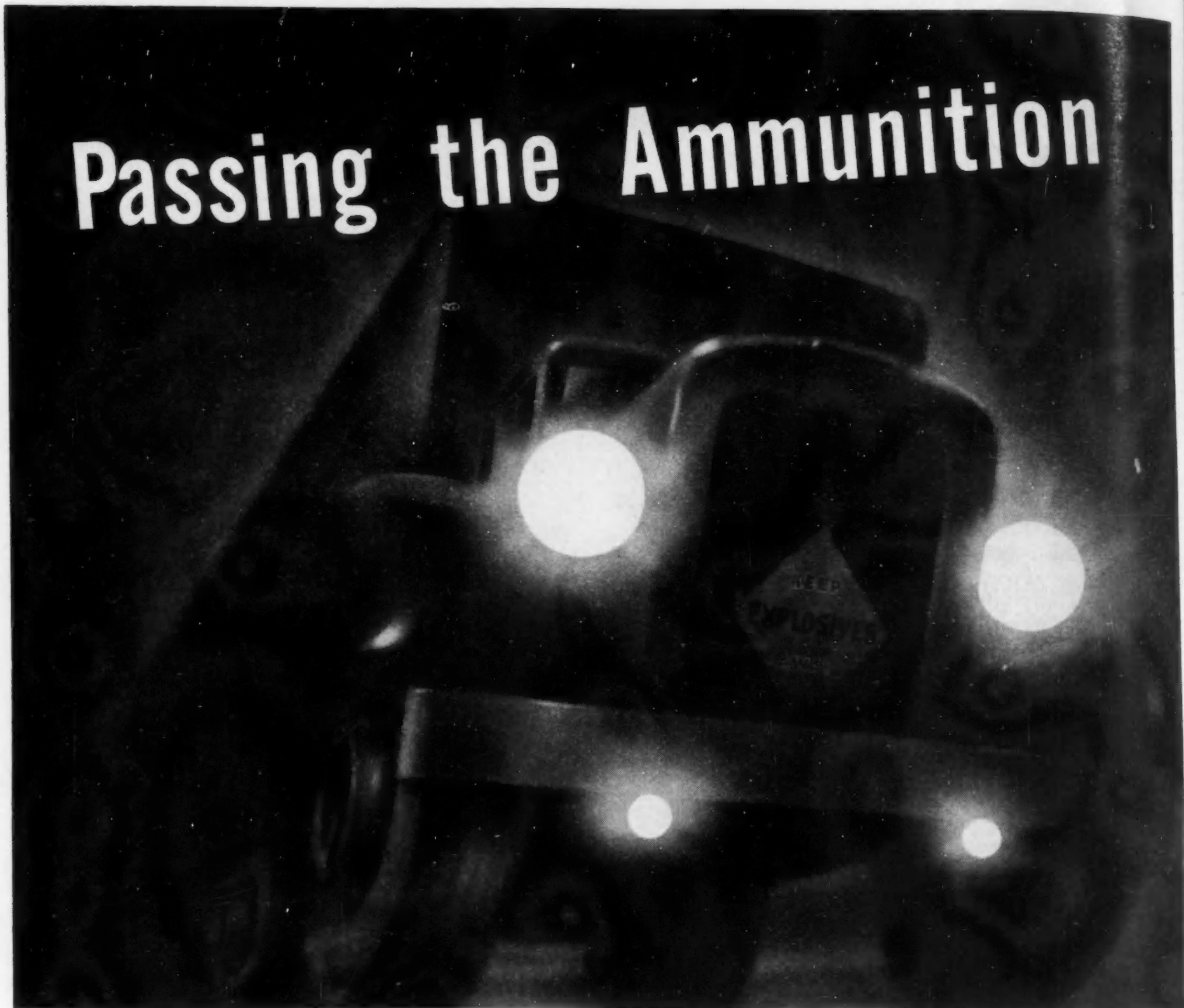
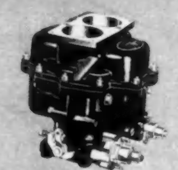
CONTENTS

JANUARY 1943

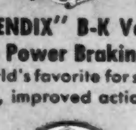
Passing the Ammunition





"STROMBERG" Carburetors . . . foremost in consistent, enduring performance.

"BENDIX" B-K Vacuum Power Braking . . . world's favorite for surefire, improved action.



"BENDIX" Brakes . . . Hydraulic and mechanical, ruggedly built, embody vital braking advantages.

A Wartime Job in Which American Automotive Servicemen Have a Vital Part

A vital part of a big wartime job has been put squarely up to the automotive servicemen of America.

Vast quantities of war materials—parts for guns, tanks, trucks and ships, as well as materials for ammunition—must move through the channels of civilian transportation from source to destination *on time*. In addition, buses and passenger cars must move our vast army of civilian war workers to and from the production lines each day.

In short, civilian transportation must move both men and materials—and do it at peak efficiency, regardless of shortages and curtailments.

Bendix, while in the thick of war-production, is fully aware of its part in backing up the service industry with parts and service replacements for this essential civilian transportation.

In addition to the parts themselves, Bendix has prepared and offers valuable wartime "know how" manuals that are helping servicemen make limited supplies of repair parts and materials go farther and do a better job.

So, in these critical times of war, as in the days of peace, it is the privilege of Bendix to work shoulder to shoulder with America's automotive industry—helping it fulfill its destined part in "Passing the Ammunition."

BENDIX PRODUCTS DIVISION

Products made by this Division serve with "The Invisible Crew"—precision-built instruments and equipment which 25 Bendix plants from coast to coast are speeding to our fighting crews on world battle fronts.

THE INVISIBLE CREW
Precision Equipment by Bendix
AVIATION CORPORATION

ENGINEERING Design for Air Cargo System

Evolved at Epochal SAE Conference in Chicago

by
AUSTIN W. STROMBERG

(Photographs by Robert J. Temple)

CLOSE of the historic two-day SAE Air Cargo Engineering Meeting staged Dec. 8-9 at the Knickerbocker Hotel, Chicago, marks the opening of a new chapter in air cargo history. Results from the five idea-crammed sessions, attended by over 400 key leaders in the air cargo division of the aviation industry, promise to be epoch-making in air cargo progress. For, as America's air cargo leaders sat down together and studied the ideas and developments presented in 12 informative papers on freighting by air and swapped ideas in the after-paper discussions, a new pattern was clearly in the making for America's air cargo transport system – one with greater emphasis on transportation engineering.

This important event, first of its kind to inaugurate analysis of air cargo problems on a national scale, brought together a notable gathering. Included among those present were aeronautical and research engineers, aviation representatives of the Army and Navy and Government bureaus, air line operators and traffic experts, aircraft and engine designers, leading equipment and handling experts, and truck engineers as well. All came to study ways and means to advance the design, construction, and operation of air cargo planes. They came to study terminal facilities, methods, devices, and short cuts vital to the growth and progress of transporting freight through the air.

From the opening session on Tuesday morning on air-line cargo problems to the closing session Wednesday afternoon on cargo gliders, the meeting set a fast pace in exploring the problems of air cargo design and transportation of freight by air. Voiced frequently in the sessions were assertions that the time is now ripe for vast changes and improvements in air cargo technique, following the great strides in air cargo transport by the armed services. Success of the Army and Navy in air transport of large tonnage over vast distances, it was agreed, offers much valuable information on what to do and what not to do in peacetime movement of freight by air cargo.

Today's need is a transportation engineering approach, agreed technicians, to replace expediency and improvisation of the swaddling-clothes period of air cargo progress. Applied transportation engineering, it was felt, will foster definite standards for specialized freight carrying equipment, provide for the building of a sound rate structure, and furnish traffic managers of air cargo lines with a new background for educating shippers on the comparative value of air transport in relation to surface transportation.

A pioneer event, this first Air Cargo Engineering Meeting appeared perfectly at home in Chicago, hub of the nation's network of air lines, and center of the industry's newest aviation plants. Its skillful handling by the Chicago Section evoked praise from many of the aviation leaders in attendance. This Section, host to the air cargo visitors, in cooperation with the SAE Aircraft activity, the Air Transportation Association, and the Aeronautical Chamber of Commerce, presented a smooth-working organization that handled the sessions with clock-like precision and air-line dispatch.

Directing the meeting was R. D. Kelly, general chairman, and superintendent of development for the United Air Lines. To him should go major credit for its planning and for the arduous spade work required to produce the top-flight program of speakers. Assisting him was Chicago Section Chairman J. Howard Pile and an active array of committees:

Registration & Reception Committee: George C. Stevens, chairman; George E. Hammel, Andrew Raffay, Jr., S. T.

Left to right: Com. C. H. Schildhauer, Naval Air Transportation Service; Ray Kelly, United Air Lines Transport Corp.; Col. Harold R. Harris, assistant chief of staff, Air Transport Command, Army Air Forces. Mr. Kelly was general chairman of the meeting and to him goes major credit for planning and production of the program

Transportation Engineering Highlights

FOCAL POINTS in the formal papers and discussions calling for a new transportation twist to the engineer's slide rule were:

- **Need for standardization in floor levels, size and location of doors, arrangement of freight compartments and loading heights to facilitate handling of freight by air lines.**
- **Establishing of standards for air freight classification, terminal layout and locations, type of loading equipment and methods to reduce parking time of planes while loading.**
- **Setting up specifications for portable and permanent load fastener equipment and methods for stowage.**
- **Study of plane gross weights in terms of structural materials and available payload capacity for passenger planes, air cargo planes, and combination passenger and cargo planes.**
- **Analysis of accumulated log recorded data on most economical plane design for handling cargo transport at lowest ton-mile cost.**
- **Analysis of the elements entering into the development of a sound freight structure for high-grade air cargo freight.**
- **Further research on glider types, pick-up methods and feeder lines.**

Hoener, Clayton B. Seymour, Edward F. Donham, R. D. "Sid" Edwards, Harry L. Moir.

Program Committee: R. D. Kelly, chairman; J. Howard Pile, R. D. "Sid" Edwards, J. A. Herlihy, R. H. Brouck, Robert J. Temple.

Publicity & Publications Committee: Robert J. Temple, chairman and official photographer for all sessions; Austin W. Stromberg, Norman Panzegrau and Floyd E. Ertsman.

Banquet Tickets Committee: James T. Greenlee, chairman, Floyd E. Ertsman.

Among the dramatic highlights which featured the Air Cargo sessions and banquet program may be mentioned:

1. Presence of Mac Short, vice-president of engineering, Vega Aircraft Corp., Burbank, Calif., SAE president-elect for 1943. Mr. Short spoke at the banquet on SAE war effort activities in place of SAE President A. W. Herrington who unfortunately was unable to be present due to a death in his immediate family.

2. Presence at the banquet of Hon. Mayor Edward J. Kelly of the City of Chicago. The Mayor welcomed representatives of the aviation industry to Chicago, then spoke of the nation's pride in the accomplishments of the aviation industry and the Society of Automotive Engineers in the country's fight to victory, and stressed Chicago's rapid progress as an aviation production and operating center.

3. Resolutions passed by members at the banquet meeting commending the work of the Society of Automotive Engineers in technical phases of the country's war effort. Resolution was offered by Charles Froesch, chief engineer of the Eastern Air Lines, and after its passage, it was presented to Mr. Arthur Nutt, chairman of the SAE Aeronautics Division and vice-president of the Wright Aeronautical Corp., for transmission to SAE headquarters. In presenting the resolution Mr. Froesch said:

"I wish to refer to the aeronautics program which Mr. Short mentioned. Since our Government explicitly asked the SAE to undertake an ambitious program I have watched the results of the energetic cooperation that has been generously applied by our aeronautical industries with participation by our air lines. In full collaboration with our Government branches, several hundred of our leading engineers have, for many months, freely exchanged technical information and "know-how" in the development and application of scores of standards, specifications, and recommended practices in the branches of our work that are covered by the Government assignments. These include engines, propellers, accessories, and equipment, as well as materials for these items and for airframes. Inasmuch as the results already accomplished have been monumental and in view of the devotion that our industries and

our engineers have applied to this task, I move, Mr. Chairman, that this meeting go on record in recognition and commendation of this accomplishment which is currently of great significance in the war effort and which will be of enduring value, in times of peace, to our manufacturing industries, our air lines, our Government, and American leadership in Air Transportation."

4. Genial W. B. Stout, motordom's outstanding toastmaster, brought down the house with his famed story (Stockholm style) about the elephant browsing in Mrs. Olson's vegetable garden.

5. Amazing example of cargo transport in expediting relief in housing conditions of Alaskan workers was related by Toastmaster Stout. Within 24 hours after an order for 12 prefabricated houses was received in Detroit, he said, the houses were placed aboard passenger planes, and were delivered in the Arctic zone heated and ready for occupancy.

Igor Sikorsky, Vought-Sikorsky Aircraft Division, United Aircraft Corp., and Hon. William A. Burden, special assistant to the Secretary of Commerce, in charge of aviation. Mr. Burden assisted in development of the meeting and was chairman at an important session

AIR LINE CARGO PROBLEMS SESSIONS

William C. Littlewood, Chairman

First session of the two-day program convened at 10 o'clock Tuesday morning in the Towne Room of the Knickerbocker Hotel with an attendance of about 200. General Chairman R. D. Kelly welcomed guests and members, then introduced the technical chairman for the morning session, William C. Littlewood, vice-president of engineering, American Airlines, Inc. Mr. Littlewood introduced in turn speakers Froesch and Larson, and following presentation of the papers conducted the discussion period.

J. Howard Pile, chairman of the Chicago Section, under whose auspices the meeting was held

Historically of great importance, these sessions blazed new trails for engineers with an eye upon the future of aviation. Speakers stressed economic considerations as well as engineering phases of tomorrow's efforts.

Deficiencies of Converted Passenger Airplanes for Cargo Transport Operating Requirements – CHARLES FROESCH, Eastern Air Lines, Inc.

SHORTCOMINGS of the converted passenger plane were at least 10 in number, said Mr. Froesch, classifying them as follows: (1) floor slope and irregularity of floor at door causing concentration of load at that point; (2) floors too weak, requiring reinforcing; (3) doors too narrow for entrance of bulky loads; (4) no anchorage for load fasteners; (5) no provisions for cargo handler station; (6) hard to find a center of gravity location; (7) lavatory in the wrong place; (8) insufficient fire extinguisher protection; (9) door sill heights too variable; (10) fuselage space, where circular or oval shape, cannot be used effectively.

A big problem, said Mr. Froesch, is to keep the rate down where repeat business will follow. Eventually this might mean, he declared, a 10 to 12-cent per mile rate under proper designing. But he said, size and capacity of plane cannot be predicted until a thorough analysis of air express and freight market has been made. Mr. Froesch then projected on the screen 11 different views illustrating cargo planes of different landing gear heights and various shaped compartments with side doors that are often too narrow for loading large size objects or machinery.

A density-volume ratio of 8 to 9 lb per cu ft can be used, Mr. Froesch said, as a design criterion in figuring size of compartment. He pointed out heating and ventilation aspects of the cargo compartment and explained desirability of having cockpit close to a small compartment for protection of valuables. Lack of accessibility for preventive maintenance and regular servicing, he said, is general. Air cargo transport, he declared, should help to keep the peace in the postwar period, but meantime, he said the good word is "Praise the Lord and pass the ammunition."

Left to right: SAE Vice-President for Aircraft Peter Altman, Vultee Aircraft, Inc.; William Mentzer, United Air Lines Transport Corp.; Igor Sikorsky, Vought-Sikorsky Division, United Aircraft Corp.; and W. A. Del Valle, Pan-American Airways

Among prominent people at the Air Cargo Engineering Meeting dinner

1. William Stout, toastmaster, Stout Skycraft Corp., R. J. Temple, Lincoln-Boyce Ice Co.

2. Ray Kelly, United Air Lines Transport Corp., Mayor Kelly of Chicago, and "Sid" Edwards, United Airlines Transport Corp.

3. Barney Vierling, Pa.-Central Airlines, Charles Froesch, Eastern Air Lines, Inc., Ralph Ellinger, TWA

4. Jack Gray, Aeronautical Chamber of Commerce of America, Herb Anderson, Whiting Corp., and H. D. Hoekstra, CAA

5. William Littlewood, American Airlines, Inc., Tom Wolfe, Western Airlines, and Edward Warner, Civil Aeronautics Board

Terminal Handling of Air Cargo – KARL O. LARSON, Northwest Airlines.

PROBLEM of handling three classes of cargoes – unpackaged light pieces, unpackaged heavy units, and packaged goods in different shapes – requires, said Mr. Larson, greater simplification and standardization. He pointed out that containers used for surface-shipped goods are generally too heavy for car cargo shipping, and lighter paper or fabric covers or containers are desirable. New materials for this purpose, he said, are being tested.

Mr. Larson discussed the advantages of pallet loading with a lift truck. The pallet may be bolted to the floor, he said, thus eliminating strain of lashing. Weight of each package should be stamped on the outside, he stated. Parking space requirements for a medium sized cargo plane, he declared, are about 150 ft square, and 10,000 sq ft of terminal would require a 70-ft wide building one-story high along one 150 ft edge of berth, he asserted. For each additional berth, terminal must be extended accordingly. Alternate plan, he said, is the large central warehouse for receiving, storing and transferring, and location opposite airport is favored, with connecting underground passage. Outlining the interior arrangement details for such a terminal, he stressed the need for machine handling to keep down time loading factor and for protection of goods.

Due to variety of heights of plane doors and angles in compartments, the power conveyor system of loading is often a practical solution, he said, where goods are brought to the aircraft. Weather conditions may impede outside cargo handling, and in the end roof protection is most economical, he said. Multiple industrial truck method of loading incorporates flexibility of handling for many types of goods, Mr. Larson declared. Fork lift trucks are most adaptable, and with proper ship design that will incorporate pallet loading, this offers many advantages, he pointed out. Describing proper communications and signal facilities, he emphasized time-saving features that are necessary in expediting loading and unloading operations.

DISCUSSION

Among the commentators on the papers of Mr. Froesch and Mr. Larson were: Dr. Alexander Klemin of New York University; George H. Freyermuth, Standard Oil Co. of N. J.; Chairman Littlewood; Tom Wolfe, Western Air Lines; Harlan D. Fowler of Fowler Aircraft Co., San Diego, Calif.; Carl de Ganahl of Fleetwings, Inc., Bristol, Pa.; and Ralph Ellinger of TWA, Kansas City, Mo. Points commented upon dealt with need for loading of plane through the top by container lift, rear and front loading of plane, and importance of speeding up loading operations to reduce idle time of plane to the minimum. Mr. Froesch emphasized that costs must be brought down, and declared limitations of converted passenger planes will prevent much cost reduction until the time when large capacity planes designed for cargo use can be built.

At the conclusion of the discussion, Harlan D. Fowler of the Fowler Aircraft Co., San Diego, Calif., placed on display a movie film showing operating methods of the Fowler container loading system. The film was made to depict the modern cargo freight terminal of 1945, equipped with power lift container system for fast loading and unloading.

AIR CARGO OPERATIONS SESSIONS

Hon. William A. Burden, Chairman

At the Tuesday afternoon session, General Chairman Kelly introduced the Hon. William A. Burden, Special Assistant on Aviation to the U. S. Secretary of Commerce, who stressed the importance of the three papers to be presented on air cargo operation, particularly emphasizing the vital importance of assembling and analyzing operating costs with the view of building up a scientific rate structure for air cargo use in the post-war period. Mr. Burden, member of the SAE since 1939 and vice-president of the Institute of Aeronautical Sciences, is author of the book "The Struggle for Airways in Latin America," shortly to be published by the Council on Foreign Relations. Mr. Burden introduced each of the three speakers in turn and directed discussion after presentation of the papers.

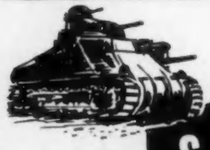
***Packaging and Handling of Air Cargo* – C. G. PETERSON, Railway Express Agency, Inc.**

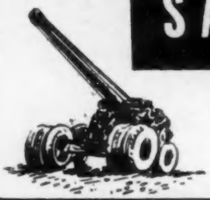
THE relation of air cargo costs to volume of tonnage carried and the vital importance of keeping loading and unloading time down to the minimum, two major items continually up for discussion at the various sessions, were thrown into strong relief by much of what

turn to page 54

SAE President-elect Mac Short, Vega Aircraft Corp., was the speaker at the Air Cargo Engineering dinner

Speakers at the SAE Air Cargo Engineering Meeting included: 1) Karl Larson, Northwest Airlines, Inc.; 2) Charles Froesch, Eastern Air Lines, Inc.; 3) C. G. Peterson, Railway Express Agency, Inc.; 4) J. Parker Van Zandt, Department of Commerce; 5) J. V. Sheehan, Lockheed Aircraft Corp.; 6) E. S. Evans, Evans Products Co.; 7) H. D. Hoekstra, Civil Aeronautics Administration; 8) Carlos Wood, Douglas Aircraft Co., Inc.; 9) Harry Stringer, All American Aviation, Inc.; 10) Major L. D. Barringer, chief, Glider Unit, Directorate of Air Support, Army Air Forces





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SAE WAR ENGINEERING P

JAN. 11-15 • BOOK-CADILLAC HOTEL, DETROIT

MONDAY, JANUARY 11

10:00 A.M. **Transportation and Maintenance**

Preventive Maintenance and Inspection Procedure
– E. N. HATCH, American Brakeblok Div., American Brake Shoe and Foundry Co.

10:00 A.M. **Ammunition and Artillery**

Steel Cartridge Cases
– LT.-COL. H. R. TURNER, U. S. Army

Steel Cartridge Cases
– R. B. SCHENCK, Buick Motor Div., General Motors Corp.

2:00 P.M. **Transportation and Maintenance**

Training of Mechanics
– FLOYD PATRAS, Southwestern Greyhound Lines, Inc.

2:00 P.M. **Ammunition and Artillery**

Specifying Surface Finishes in Gun Manufacture
– HAROLD WHITE, Olds Motor Div., General Motors Corp.

Material Application in Gun Manufacture
– M. F. GARWOOD and E. H. STILWILL, Chrysler Corp.

8:00 P.M. **Junior Student**

Auspices of Detroit Section

The Training of Technical Specialists for the Armed Forces
– BRIG.-GEN. S. G. HENRY, Armored Force

TUESDAY, JANUARY 12

10:00 A.M. **Military Vehicles Maintenance**

Cooperation of Vehicle Manufacturers in Army Maintenance Program
– BRIG.-GEN. JAMES KIRK, Ordnance Department

10:00 A.M. **Aircraft Engine**

Carburetion for the Aircraft Engine
–FRANK J. WIEGAND, Wright Aeronautical Corp.

Aviation Power Plants
– SANFORD A. MOSS, General Electric Co.

Tool Shop Organization and Methods
– W. F. PICCH, Ford Motor Co.

2:00 P.M. **Ammunition and Artillery**

The Why of Shell Metallurgy Specifications
–COL. H. H. ZORNIG, Ordnance Department

How Shell Metallurgical Specifications Are Being Met
– C. L. EKSERGIAN, Budd Wheel Co.

Hitting the Target
– CAPT. A. S. WOTHERSPOON, U. S. Naval Ordnance

2:00 P.M. **Aircraft Engine**

Determination of Stresses in Aircraft Engines
– CHARLES LIPSON, Chrysler Corp.

New Materials for Aircraft Engines
– M. H. YOUNG and H. HANINK, Wright Aeronautical Corp.

8:00 P.M. **Business Session**

Nomination and Election of Members-at-Large of Annual Nominating Committee

Announcement of Election of Officers for 1943

Presentation of Life Membership

The SAE At War
– B. B. BACHMAN, Chairman, SAE War Activity Council

8:30 P.M. **Production**

The Conversion of Plants of the Automotive Industry to War Production
–JOSEPH GESCHELIN, Chilton Co.

Automotive Industry's Manufacturing Program for U. S. Army
– BRIG.-GEN. JOHN K. CHRISTMAS, Ordnance Department

WEDNESDAY, JANUARY 13

10:00 A.M. **Military Vehicles**

American Combat Vehicles
– LT.-COL. E. L. CUMMINGS, Ordnance Department

Service Conditions Faced by Military Vehicles
– LT.-COL. J. M. COLBY, Ordnance Department

10:00 A.M. **War Conversion**

A Body Plant Goes to War
– L. B. RIVARD, Lincoln Motor Div., Ford Motor Co.

The Application of Flash Welding to Aircraft
– ROBERT N. MILMOE, Lockheed Aircraft Corp.

2:00 P.M. **War Vehicles Materials**

Production Experiences with NE Steels
– R. W. ROUSH, The Timken-Detroit Axle Co.

Substitute Materials – Have We Gone the Limit?
– JOHN G. WOOD and R. F. SANDERS, Chevrolet Motor Div., General Motors Corp.

MEETING WILL BE THE

PRODUCTION MEETING

and Engineering Display

6:30 P.M. **Dinner**

(Limited to SAE members, applicants and members of the Armed Services)
E. W. AUSTIN, Chairman Detroit Section
K. T. KELLER, Toastmaster
A. W. HERRINGTON, President SAE
MAC SHORT, President-elect

Ordnance Automotive Experience in This War
– MAJOR-GEN. L. H. CAMPBELL, JR., Chief of Ordnance

THURSDAY, JANUARY 14

10:00 A.M. **Fuels and Lubricants**

The Army Requirements of Fuels and Lubricants
– BRIG.-GEN. WALTER B. PYRON, Chairman, War Department Committee on Liquid Fuels and Lubricants

Influence of Engine Adjustment and Octane Number on Performance of Commercial Engines
– D. P. BRENZ, H. H. MAXFIELD and A. B. CULBERTSON, Shell Oil Co.

Effect of Altitude on the Knocking Tendency of Engines
– D. B. BROOKS, National Bureau of Standards

10:00 A.M. **Aircraft**

Accessory Power for Aircraft
– MAJOR T. B. HOLLIDAY, U. S. Army Air Corps, Wright Field

Cabin Supercharging in Scheduled Airline Operation
– R. L. ELLINGER, Transcontinental and Western Air, Inc.

2:00 P.M. **Fuels and Lubricants**

Corrosion of Bearing Alloys
– L. M. TICHVINSKY, U. S. Naval Engineering Experiment Station

Piston Ring Scuffing as a Criterion of Oil Performance
– GEORGE H. KELLER, Wright Aeronautical Corp.

The Influence of Lubricating Oil Viscosity on Cylinder Wear
– H. A. EVERETT, Pennsylvania State College

2:00 P.M. **Aircraft**

The Determination of Fuselage Moments
– C. E. PAPPAS, Republic Aviation Corp.

Aircraft Structural Testing
– B. L. SPRINGER, Civil Aeronautics Administration

8:00 P.M. **Cooperative Research**

Cooperative Research Comes of Age
– C. B. VEAL, Cooperative Research Council

FRIDAY, JANUARY 15

10:00 A.M. **Diesel Cold Starting**

SYMPOSIUM
A. J. BLACKWOOD, Leader

ENGINE DESIGN

The Effect of Injection Pumps on Cold Starting
– M. M. ROENSCH, Chrysler Corp.

Cranking Power and Torque Requirements at Sub-Zero Temperatures
– H. L. KNUDSEN, Cummins Engine Co.

FUELS AND LUBRICANTS

Lubricants
– J. C. GENIESSE, Atlantic Refining Co.

Cold Starting Tests on Diesel Engines
– H. R. PORTER, Standard Oil Co. of Calif.

Fuel Addition Agents
– G. H. CLOUD, Standard Oil Development Co., Esso Laboratories

Progress Report on Cold Starting Data of the Automotive Diesel Fuels Division of the CFR
– F. C. BURK, Atlantic Refining Co.

ACCESSORY EQUIPMENT

Storage Battery Performance at Low Temperatures
– J. H. LITTLE, Chevrolet Motor Div., General Motors Corp., and
– R. A. DAILY, Delco-Remy Div., General Motors Corp.

The Importance of Accessory Equipment in Cold Starting of Diesel Engines
– W. J. PELIZZONI, International-Plainfield Motor Co.

PRACTICAL EXPERIENCES

– LT.-COL. C. E. CUMMINGS, Ordnance Department

2:00 P.M. **Diesel Superchargers**

The Elliott-Lysholm Supercharger
– ALF LYSHOLM, Aktiebologet Liungstrom, Augturbin, Sweden; R. B. SMITH, Elliott Co.; and W. A. WILSON, Elliott Co.

Hamilton-Whitfield Blower
– J. E. WHITFIELD, General Machinery Corp.

Army Air Forces Materiel Command Administers Gigantic Aircraft Program

by
LESLIE PEAT

COMMANDING GENERAL

Official photographs, U.S. Army Air Forces

Major - Gen. OLIVER P. ECHOLS, head of a vast engineering and manufacturing program which has already made industrial history

CHIEF OF STAFF

Brig.-Gen. BENNETT E. MEYERS, chief of staff, Materiel Command

COMMANDING general of the Army Air Forces Materiel Command is as much at home with fantastic engineering developments as he is with the astronomical figures involved in purchasing the Army Air Forces fighting equipment.

Little may be printed of the former, although hundreds of SAE members are hard at work on projects which will make a brilliant chapter on research and engineering history when it can be told. (See page 59.)

The Army aircraft program, administered by Major-Gen. Oliver P. Echols, now totals something like $55 billions, an analysis of the appropriations made by Congress, and other funds earmarked for this purpose, shows. This huge sum is approximately:

- Equal to the total national federal debt of the United States as of a year ago, or
- Equal to the total of all cash incomes of the Federal Government for the ten fiscal years of 1933 to 1942, inclusive, or
- About equal to the estimated expenditures for all businesses and services during the calendar year of 1932 – one of the several definitions of the "national income" for that year.

As commanding general of the Materiel Command, AAF, General Echols is responsible to Lt.-Gen. H. H. Arnold for:

- Research and developments of fighter, bomber, cargo, and training aircraft. This part of the program embraces work on future design of the ships, engines, propellers, accessories and equipment of all kinds – a variety of projects far larger than any aircraft manufacturer would undertake in peace times.
- Procurement,
- New facilities, and
- Production

Although the headquarters of the Command is in Washington, the principal activity of the Materiel Command is in the AAF Materiel Center, Wright Field, Dayton.

Wright Field has been the center of Army aeronautical engineering development since just before the last war, and today is a huge establishment where development, engineering, procurement, and production of most of the huge program is being administered.

To further decentralize the operation of the Materiel Command, the United States has been divided into four Procurement Districts (see map). These districts report to Wright Field.

Reared on the campus of the University of Virginia, the son of a brilliant mathematician and professor, Gen. Echols joined the Army as a second lieutenant of Field Artillery in 1916. Soon after the United States declared war, he sailed for France with the AEF, and was transferred to the 1st Aero Squadron as an observer. He fought at Chateau Thierry, St. Mihiel, and Meuse-Argonne with distinction. He is rated as a Combat Pilot and Combat Observer.

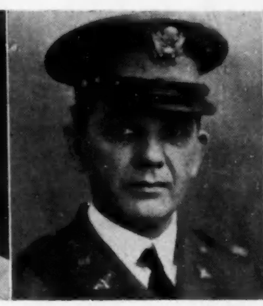
Most of his service since the war was at McCook and Wright Fields. He became superintendent of the Central Procurement District at Dayton in 1940, became officer in charge of research, procurement, supply, and maintenance, and was Commandant of the Air Corps Engineering School.

Assistant Chiefs of Staff, Materiel Command

ADMINISTRATION

Col. D. F. Fritch

CONTRACTS



Col. W. F. Volandt

ENGINEERING

Brig.-Gen. B. W. Chidlaw

PRODUCTION

Col. J. W. Sessums, Jr.

RESOURCES

Brig.-Gen. F. M. Hopkins, Jr.

AAF MATERIEL CENTER, WRIGHT FIELD, DAYTON

COMMANDING GENERAL

Brig.-Gen. A. W. VANAMAN, who heads up the huge operations of the Materiel Center

CHIEF OF STAFF

Col. A. R. CRAWFORD

Gen. Echols was appointed chief of the AAF Materiel Command last March.

Brig.-Gen. Bennett E. Meyers, a private in the Enlisted Reserve Corps in 1918, was soon graduated as a first lieutenant, and has held important posts in the growing air arm of the Army. He is rated as a Pilot, Combat Observer, and Technical Observer, and today is the Chief of Staff, Materiel Command, Washington.

Key men of the Washington headquarters of the Command are:

• Colonel D. F. Fritch, Assistant Chief of Staff, Administration. He is at the nerve center of the Materiel Command's coast-to-coast organization. He is a Command Pilot and Combat Observer.

• Colonel W. F. Volandt, Assistant Chief of Staff, Contracts, first served in the Army Medical Corps, but was commissioned a lieutenant in the Signal Corps, and saw active service.

• Brig.-Gen. B. W. Chidlaw, Assistant Chief of Staff, Engineering, was graduated from the U. S. Military Academy in the Air Service in 1922. He served at Clark Field, Philippine Islands, stationed there for two years. He became chief of the Engineering Section, Air Corps Supply Division, in 1939, and was later in charge of the Experimental Engineering Branch. He is Command Pilot and Combat Observer.

• Colonel J. W. Sessums, Jr., Assistant Chief of Staff, Production, was graduated as a flying officer in 1929, took his B.S. in mechanical engineering from the University of Tennessee in 1926, and took graduate work in the Air Corps Engineering School in 1935. He is rated as a Senior Pilot and Combat Observer.

• Brig.-Gen. F. M. Hopkins, Jr. is Assistant Chief of Staff, Resources. He joined the New York National Guard in 1917, and was commissioned in the Coast Artillery in 1918. He served in the Schools of Aerial Observation and Gunnery and in 1920 served in Germany at Coblenz and at Weissenthurm. He was professor of Military Science and Tactics at New York University for four years, returning to active duty in 1931. He was assistant commandant of the Air Corps Engineering School in 1932, and graduated from the Air Corps Tactical School in 1937. From assistant executive officer, Materiel Division, he became chief of the Facilities Section of that office in 1940. He is a Command Pilot and Combat Observer.

Materiel Center, Dayton

Commanding General of the Materiel Center, the huge operational center of the Materiel Command, is Brig.-Gen. Arthur W. Vanaman. He was commissioned a lieutenant in the Signal Corps Reserve in 1918, on active duty. He was commissioned first lieutenant in the regular Army in 1920, served in the Philippines for three years, and was graduated from the Air Corps Engineering School in 1930. He served as Assistant Military Attache for Air in Berlin, and upon his return from Germany was assigned to duty at Wright Field. He was promoted to brigadier general last March. He is rated as a Command Pilot and Combat Observer.

General Vanaman's chief of staff is Col. A. R. Crawford, a graduate of the U. S. Military Academy, who is rated as a Command Pilot and Combat Observer.

The three main divisions of the Materiel Center are Engineering, Production, and Procurement.

The four Procurement Districts also report directly to General Vanaman.

Engineering

Brig.-Gen. F. O. Carroll is commanding general of the Engineering Division. His command is over three sections, where the new development work is administered. They are:

• Laboratories Section, where the aircraft, engine, and accessory projects of the Army's fighting aircraft of the future are being developed.

• Experimental Projects Section, and

ENGINEERING

Brig.-Gen. F. O. CARROLL, chief of the Engineering Division, who is responsible for future design developments and improvements in aircraft and equipment

PRODUCTION

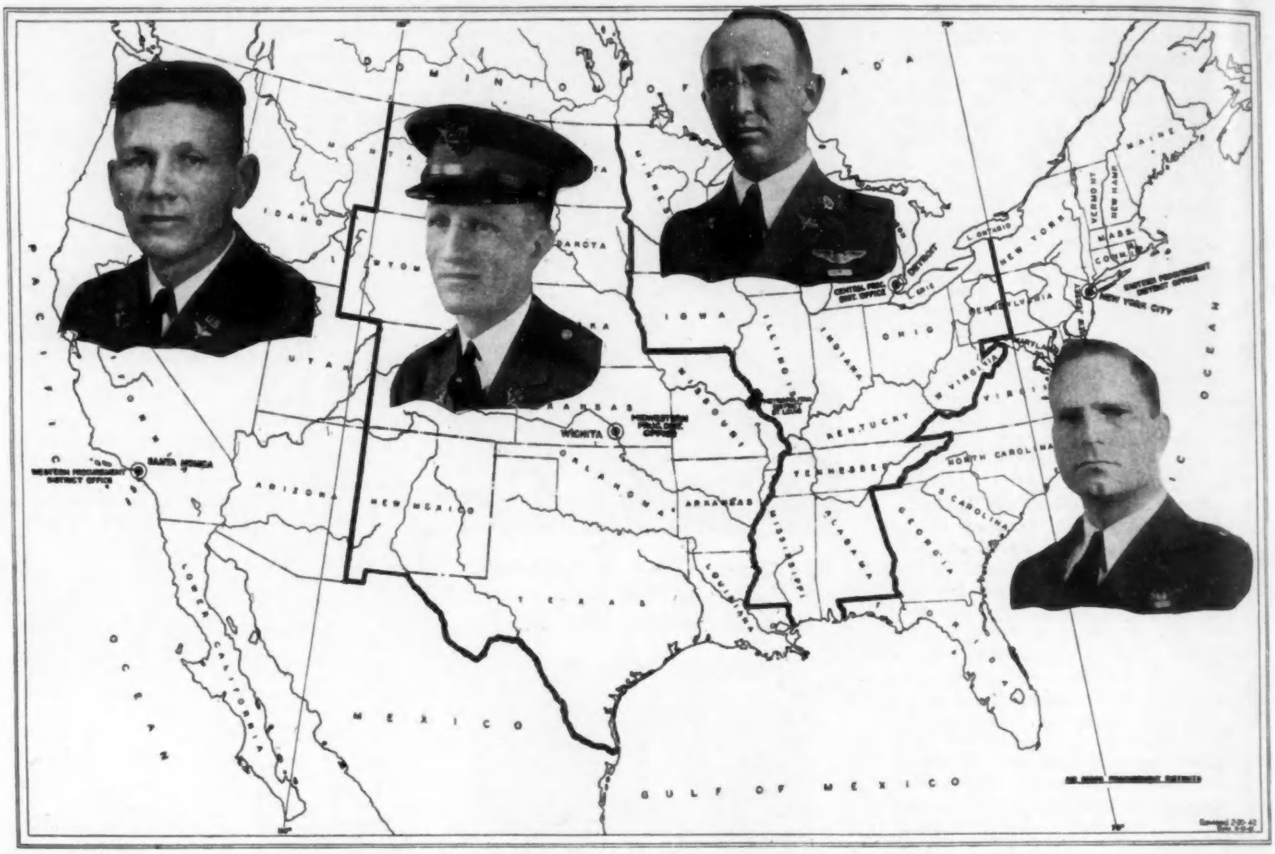
Brig.-Gen. K. B. WOLFE, who heads the vast production plant of the AAF Materiel Center, and is responsible for improved aircraft production methods

PROCUREMENT

Brig.-Gen. A. E. JONES, head of the Procurement Division. His staff negotiates contracts for the big Army aircraft program involving thousands of contracts

DECENTRALIZED PROCUREMENT DISTRICTS, MATERIEL CENTER, AAF

WESTERN MIDWESTERN CENTRAL EASTERN



Brig.-Gen. C. E. BRANSHAW, Santa Monica, California **Col. R. G. HARRIS, Wichita, Kansas** **Col. A. M. DRAKE, Detroit, Mich.** **Col. O. R. COOK, New York City**

• Technical Data Section, which supplies the engineers with a vast amount of engineering information.

Gen. Carroll was graduated from the University of Illinois as a Bachelor of Science, enlisted in the Illinois National Guard as a cavalryman, and enlisted in the Signal Reserve as a flying cadet and commissioned a first lieutenant in 1918. He graduated from the Air Service course, Massachusetts Institute of Technology in 1920, completed the Army's Air Service course in 1921, went to McCook Field, Dayton, as assistant to the chief engineer in 1925. He became the assistant chief, Experimental Engineering Section, Wright Field, and in 1929 was appointed chief of the Airplane Branch. He saw field service in Panama, and returned to become Air Corps representative at Douglas and North American. He served as Assistant Military Attache, London, in 1940, and returned to engineering duties as chief of the Experimental Engineering Section, one of his three commands. He is a Command Pilot and Combat Observer.

Production

Brig.-Gen. K. B. Wolfe, Commanding General of the Production Division, enlisted in the Army in 1918, and soon was commissioned a lieutenant. He served at Clark Field, Philippines, as Plans and Operations Officer in 1926. Upon his return, he served at several fields and was graduated from the Air Corps Engineering School in 1930, when he was appointed chief of the Inspection Branch. He graduated from several Air Corps Schools, and was assigned as Air Corps Representative at Douglas. From assistant chief of the Production Engineering Section, he was appointed chief in 1940. He is rated as a Command Pilot and Combat Observer.

Gen. Wolfe's four Sections are:

- Production Engineering Section,
- Production Control Section,
- Industrial Planning Section, and
- Special Projects Section.

Here is the focal point for the actual manufacturing of the aircraft, engines, propellers and parts, in several thousand factories throughout the country ranging in size from the Ford Willow Run Bomber plant with its 73 acres of roof, to subcontractors' establishments of relatively insignificant size but of vital importance to the whole program.

One of the most dramatic of all post-war stories will be the record of turning a large part of the automobile and accessory industry of the United States into aircraft, aircraft engine, and accessory factories for the duration.

Unfortunately for the Axis, many of these companies had been builders of precision products for many years. More unfortunately for the Axis, all of them got retooled faster than many outstanding production engineers believed possible. Most unfortunately for the Axis, Gen. Wolfe quickly organized the far-flung industrial plant into a close-knit, cooperative unit, which will stand for all time as a landmark in industrial history.

Procurement

Brig.-Gen. A. E. Jones is the commanding general of the Procurement Division, Materiel Command. He graduated from Kenyon College in 1912, and was commissioned a lieutenant in the Aviation Section, Army Signal Corps, in 1917. He took postgraduate work in aeronautical engineering, Massachusetts Institute of Technology, graduating in 1918. He served for three years in the Canal Zone, and after more graduate work in Air Corps Schools and service at several fields, became assistant chief of the Contract Section in 1939. He is rated as a Command Pilot, Combat Observer, and Technical Observer.

His command is administered through these four Sections:

- Administrative Section,
- Purchase Section,
- Contract Section, and
- Procurement Control Section.

He has liaison with the Price Adjustment Office, which reports to the commanding general of the Materiel Center.

The Air Plant Protection Section, Inspection Section, and Flight Section also report directly to Gen. Vanaman.

The four procurement districts, command-

turn to page 53

ENGINE BEARINGS: REPLACEMENT—
Technique for Installation or Fitting

Report of Subcommittee, Maintenance Methods Coordinating Committee, SAE Transportation and Maintenance Activity, Submitted to the Vehicle Maintenance Section, Division of Motor Transport, Office of Defense Transportation

* * *

Section I

THERE are three types of engine main and connecting-rod bearings in common use, classified according to their mechanical features. A description of these types is given in Table 1 together with associated material combinations. Additional description is provided by Figs. 1, 2, 3, and 4.

■ Range of Undersize Bearings

A large percentage of engine models have been produced with precision insert (interchangeable) main and connecting-rod bearings.

Subcommittee on "Engine Bearings: Replacement – Technique for Installation or Fitting" – A. B. Willi, chairman, chief engineer, Federal-Mogul Corp.; R. Creter, service manager, Cummins-Diesel Engine Corp. of N. Y.; Ray F. Crom, manager, McQuay-Norris Mfg. Co.; G. L. Ferguson, engineer, Monmouth Products Co.; Earl Ginn, vice president, Continental Motors Corp.; Charles R. Lynch, branch manager, Clawson & Bals, Inc.; W. R. Waddell, service manager, Federal-Mogul Corp.; E. P. Gohn, project chairman.

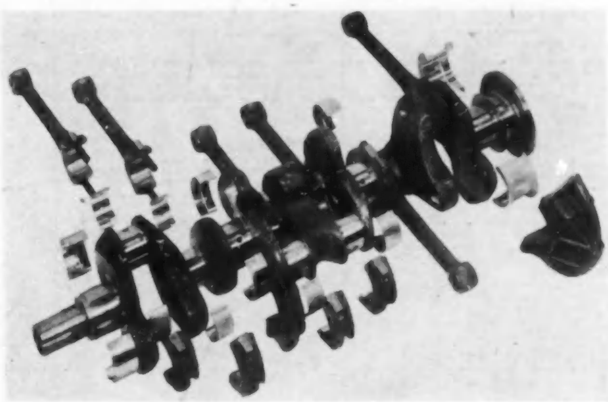
SAE Maintenance Methods Coordinating Committee – W. J. Cumming, chairman, chief, Vehicle Maintenance Section, Division of Motor Transport, Office of Defense Transportation; E. P. Gohn, test engineer, The Atlantic Refining Co.; M. E. Nuttila, superintendent, Motor Vehicles, Cities Service Oil Co.; G. W. Laurie, manager, Automotive Transportation Department, The Atlantic Refining Co.; Col. T. L. Preble, War Department, Office of Chief of Ordnance; J. Y. Ray, supervisor, Automotive Equipment, Virginia Electric & Power Co.; S. B. Shaw, automotive engineer, Pacific Gas & Electric Co.; W. A. Taussig, automotive engineer, Burlington Transportation Co.; E. W. Templin, automotive engineer, Los Angeles Department of Water & Power; D. K. Wilson, superintendent, Automotive Equipment, N. Y. Power & Light Corp.; A. M. Wolf, automotive consultant.

When the same precision insert bearing has been used in production during a period of years, a wide range of undersize replacement bearings has been demanded so as to match crankshaft wear and successive regrindings. In Table 2 is shown the record of the connecting-rod bearings used in two popular medium-size truck engines with respect to range of sizes furnished, and the percentage sold of each size. Data are taken from the records of one manufacturer for the year 1941 and four months of 1942.

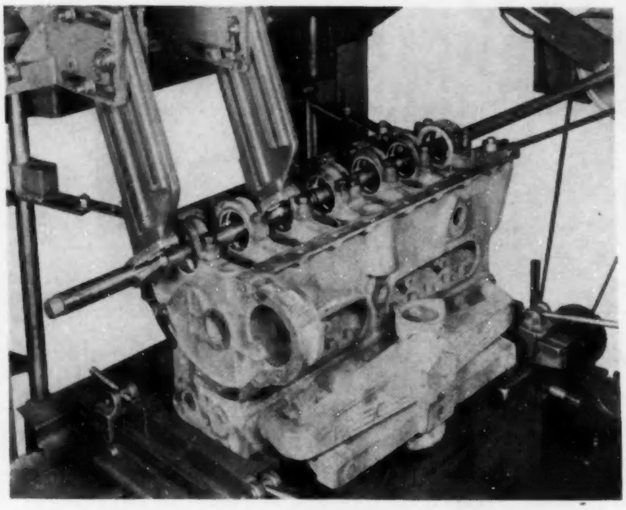
The range of undersizes does not represent standard practice on all engines as the size range is variable, and in commercial vehicle engines particularly, it depends largely on local conditions.

Many replacement precision insert bearings are supplied only as standards, 0.002-in. undersize and 0.060- or 0.090-in. undersize; the latter being semi-finished on the inside diameter. These are either finished to size at assembly or are bored to the desired size in special bearing sizing machines in local facilities.

One builder (Chrysler) has regularly produced engines with two connecting-rod bore sizes; standard and 0.005-in. oversize. The use of the 0.005-in. oversize has been a means of salvaging rods which would otherwise have been scrapped. Another manufacturer (Ford) rebuilds many engines as a production proposition using connecting rods which have been refinished undersize in the crankpin bore, in combination with undersize crankshafts.



■ Fig. 1 – Type I precision insert (interchangeable) main and connecting-rod bearings



■ **Fig. 2 – Finish-align boring Type 2 main bearings after pre-assembly in crankshaft**

After long service, many connecting rods originally fitted with precision insert bearings become warped and out-of-round in the bearing saddle bore. Correction to restore true bore roundness is often made locally by regrinding or honing to 0.005- or 0.010-in. oversize.

A condition thus exists whereby certain replacement bearings have been required which are not only undersize on the inside diameter but also *oversize* on the outside diameter.

■ Construction of Undersize Bearings

Materials used for bearing linings (tin- and lead-base babbitts, cadmium alloys, and copper-lead mixtures) are low in certain physical properties, and they are used in combination with a higher-strength back structure of steel or bronze (see Fig. 5). Until comparatively recently, the back thickness *A* remained the same for standard-size bearings and all associated undersizes. The lining thickness *B* was a variable and changed with the different bearing sizes. This arrangement made it possible to more economically manufacture relatively small quantities of assorted undersize bearings for replacement along with large quantities of standard-size original equipment bearings, since no separation for final size was made prior to the final bore sizing operation. Another important advantage of this construction is availability, since a 0.060-in. undersize semi-finished bearing can be bored to standard or any intermediate undersize. Similarly, any undersize bearing can be rebored to standard or smaller undersize.

A late development in engine bearing design has been a rather drastic reduction in bearing lining thickness (to a range of approximately 0.002- to 0.010-in.), primarily to improve bearing mileage. To carry the benefits of this development as far as possible, many undersize bearings are now made with variable back thicknesses so that the lining thickness can be held more closely in accord with the thickness used in the standard shaft size bearing.

For example, certain manufacturers supply 0.060-in. undersize bearings with a steel-back thickness which will allow machining to a 0.030-in. undersize. For undersizes between 0.030-in. and standard, a 0.030-in. undersize bearing is furnished which can be machined to standard.

Due to uncertainties in the availability of steel and bronze used for bearing backs, additional variations in back thicknesses are not improbable. Realizing the hazards of this condition, most replacement bearing manufacturers are packing a suitable notice in bearing cartons stating the minimum undersize or range of undersizes to which the bearing can safely be bored. In some cases this information is rubber-stamped on the bearing back surface, or on the outside of the carton (see examples in Fig. 6). When any undersize bearing is rebored to another size, it is important to make sure that the desired size can be obtained from the bearing selected.

The use of very thin linings has not been extended to the Type 2 (see Table 1). "Removable align bored" bearing, and relatively few engine models are currently built with this type of bearing. It can be safely assumed that stock bearings of this type can be bored to standard or any undersize within their rated range.

The lining in direct-babbitted connecting rods and

Type 1 Precision Insert Bearings (Interchangeable) No boring, reaming or otherwise fitting required to prepare bearings for shaft	Type 2 Removable Bearings Bored or reamed to exact size after pre-assembly in crankcase or connecting rod	Type 3 Direct Babbitted Bearings As applied to connecting rods or bearing caps Bored or reamed to exact size at assembly
Advantages- Ease of replacement and lower assembly cost. Not necessary to remove piston and rod assembly to replace connecting rod bearings. Not necessary to completely remove crankshaft to replace the main bearings Installation can be made by a mechanic with limited training No special machine or tool equipment is required to make an emergency repair in the field *Disadvantages*- Inaccuracies in dimensions and out of roundness of bearing saddle bores in connecting rod and crankcase will be closely duplicated by bearings after assembly Misalignment, warpage and bow in crankcase cannot be corrected by installation of new bearings	*Advantages*- More accurate replacement job. Dimensional inaccuracies and crankcase bearing saddle bore misalignment, warpage and bow are automatically corrected during the final boring or reaming operation *Disadvantages*- Replacement is more difficult. Piston and rod assemblies must be removed to replace connecting rod bearings. Engine must be removed from chassis to replace main bearings A more or less extensive set of boring or reaming equipment is necessary. A skilled operator is required to set-up and operate the boring or reaming equipment	*Advantages*- Same as for Type 2 *Disadvantages*- Same as for Type 2
Material- Tin base babbitt applied to a steel or bronze back Lead base babbitt applied to a steel or bronze back Cadmium alloy bearing metal applied to a steel back Copper-lead bearing metal applied to a steel back	*Material*- Same as for Type 1	*Material*- Tin base or lead base babbitt directly applied to connecting rod or, in a few cases, to the bearing cap forging Note: Direct-babbitted caps must be used with align bored (or reamed) upper bearing shells

Table 1 - Types of Engine Main and Connecting-Rod Bearings

bearing caps is cast in sufficient thickness to bore to any desired size.

■ Recommended Range of Stock Bearings

Precision Insert (Interchangeable) Bearings (See Type 1, Table 1).

Standard

0.002-in. undersize (to lengthen time before first crankshaft regrind).

0.010-in. undersize.

0.020-in. undersize.

0.030- or 0.040-in. undersize.

0.060- or 0.090-in. undersize semi-finished. Rebore as required for intermediate undersizes.

Note: In certain cases, the above undersizes are required with a 0.005- *or* 0.010-in. *oversize* outside diameter.

Removable Bearings – Align Bored (See Type 2, Table 1).

0.060- or 0.090-in. undersize.

■ Bearing Material Substitutions

Copper-lead and cadmium alloy bearings are commonly used in heavy-duty engines where the loads and operating conditions are too severe for conventional tin-base or lead-base babbitts.

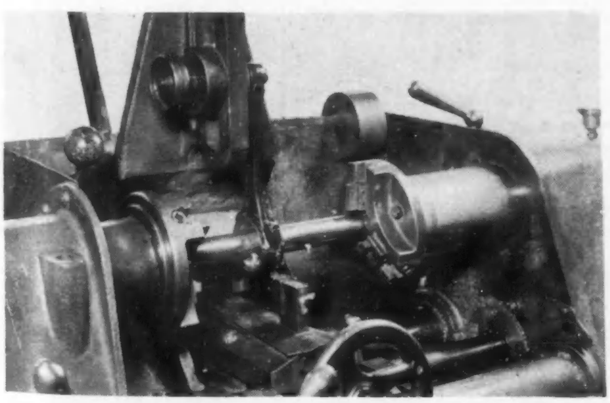
Copper, cadmium, and tin are obtainable only on high priorities, and the availability of these metals for replacement bearings in commercial operations is questionable at this time. The alternative is a lining of lead-base babbitt.

No lead-base babbitt bearing can be expected to show mileage which is equivalent to that of copper-lead or a cadmium alloy bearing in an engine originally built with the heavy-duty bearings. If this substitution is necessary, the operator must expect reduced bearing mileage or he must reduce the severity of his operation.

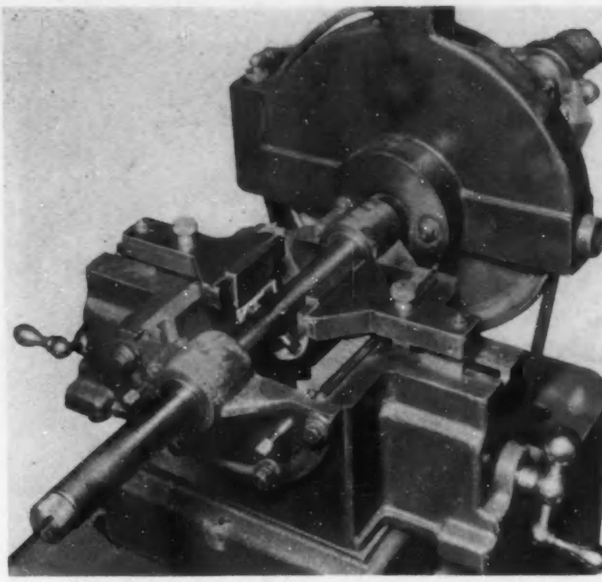
Lead-base babbitts, as used by the several specialist engine bearing manufacturers, can be expected to show mileage which is superior to that of tin-base babbitt bearings *providing* the babbitt thickness does not exceed 0.035-in. If the babbitt thickness ranges between 0.035- and 0.060-in., the performance of lead-base and tin-base babbitt can be expected to be on a par. If the thickness of a lead-base babbitt is in excess of 0.060-in., its performance will probably be inferior to that of tin-base babbitt unless the severity of the operation is reduced.

Table 2 – Size Range and Sales Demand of Selected Replacement Connecting-Rod Bearings

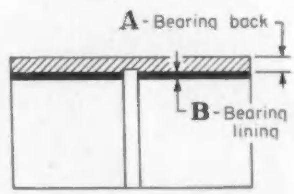
Rod Bearing "A" 1934 to 1942		Rod Bearing "B" 1937 to 1942	
Size	Demand %	Size	Demand %
Standard	42.81	Standard	48.75
0.001 Under	24.31	0.001 Under	20.42
0.002 "	12.43	0.002 "	12.96
0.003 "	3.99		
0.005 "	2.30	0.005 Under	0.22
0.010 "	4.95	0.010 "	5.28
0.012 "	0.75		
0.015 "	0.25		
0.020 "	4.74	0.020 Under	7.40
0.030 "	2.36	0.030 "	3.12
0.040 "	0.44	0.040 "	0.12
0.060 Semi-Fin.	0.67	0.060 Semi-Fin.	1.73



■ Fig. 3 – Finish-boring Type 3 direct-babbitted connecting rod



■ Fig. 4 – Machine set-up for boring semifinished Type I precision insert main or connecting-rod bearings to required size



■ Fig. 5 – Cross-section of bearing showing thickness of back and lining

■ Fig. 6 – Special size information on typical undersize bearings and cartons

■ Restoration of Standard Diameters

When crankshafts have been reground to the limits established by available undersize bearings, it is obvious that any further reduction in diameter is impractical because of lack of suitable bearings, and what is perhaps of greater importance, the shaft may be dangerously weakened by additional regrinding.

Since it is improbable that new shafts will be freely available for replacement purposes, it may be possible to restore the crankpins and journals to their *original diameters* by available methods of applying a coating or build-up by metal spray (metallizing). The term "may be possible" is used because of possible limitations in the availability of metal spray equipment and materials. It is not within the scope of this work to describe the details of metal spraying, but it is in order to point out that this work must not be carelessly done.

The surface to be built up must be properly prepared by turning or grinding to clean up.[1] Do not cut sharply into the end fillets; round into them so as not to impair the strength of the shaft at these points.

This surface is further prepared by blasting with sand or steel grit or by special knurling or grooving tools.

Oil holes are plugged with carbon or chalk.

The prepared surface must be clean and free from oxides, oil, dirt, and water.

The sprayed metal must be finely atomized to insure that the molten particles are small enough to penetrate the finest openings in the prepared shaft surface.

Obviously, the correct metal must be applied.

Section 2
Guide for Bearing Replacement

■ Stock Storage

Replacement bearings are protected against rust and deterioration by suitable treatment and are packed in sturdy cartons. A stock of bearings should not be abused by storage in a room which may be excessively humid, damp, or contaminated by acid fumes.

Arrange the stock so that the older bearings are used first.

When bearings are issued for any job, do not remove them from their cartons to lie around on a dirty work bench. Protect them until ready to install.

■ Stamping Bearing Caps

Connecting rod and main bearing caps must be stamped to identify their location and position. During the removal of the connecting rod and main bearing caps in the engine teardown, apply or find previously applied steel-stamped numerals which indicate their location in the engine, and the end which faces the front (or the rear). Connecting rods and caps are stamped to correspond with the cylinder in which they are assembled (see Fig. 7). The crankcase and main bearing caps are logically stamped to correspond to their numerical location in the line: No. 1 for the front, 2 for the next in line, and so on.

If the caps are mixed or reversed end-to-end at assembly, the effects will certainly be damaging to the bearings.

Particular care must be used to assemble "offset" connecting rods in their correct position. If the rod is assembled in reverse, the wristpin end will ride against the piston boss, and early engine failure will result.

■ Obtain the Correct Bearings

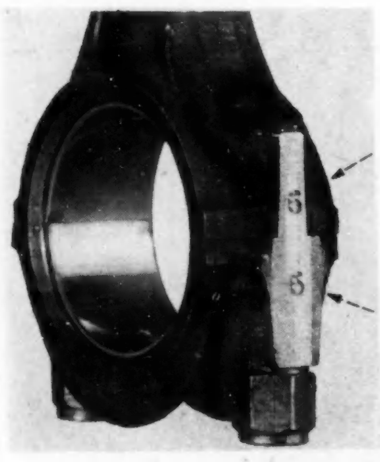
When ordering replacement bearings, be sure that the correct crankshaft sizes are known (see paragraph under "Crankshaft," and Figs 10 and 11).

Compare the new bearings with the old to insure that the proper bearings have been obtained. As a general thing, oil grooves, oil holes, and so on, should be the same on both. This is not always the case, however, since the replacement bearings were probably made at a later date than those removed from the engine and certain alterations to improve performance may have been applied to them.

■ Crankshaft Thrust Bearings – Flanged

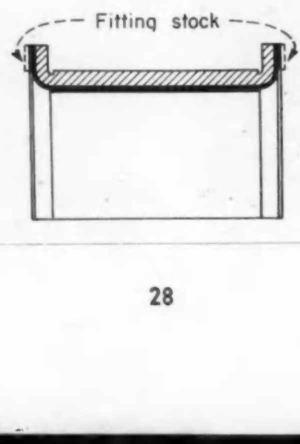
Flanged-crankshaft thrust bearings in heavy undersizes are often made with extra stock on the thrust faces (see Fig. 8) to permit fitting for correct crankshaft end clear-

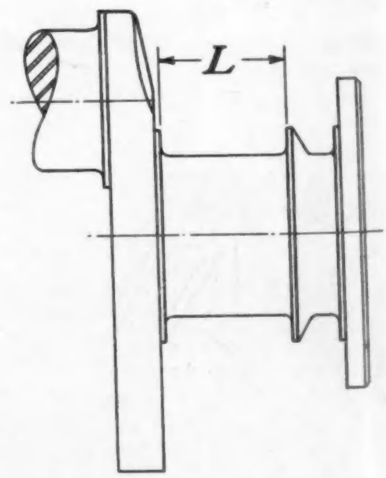
[1] See *SAE Journal*, April 1942, pp. 139-140: "Building Up of Worn Parts," by W. J. Cumming.



■ Fig. 7 – Connecting-rod blade and cap steel stamped with cylinder number

■ Fig. 8 – Undersize crankshaft thrust bearing with fitting stock on flange faces





■ Fig. 9 – To insure correct crankshaft end clearance, specify the length L between thrust collars on the crankshaft journal

ance. Undersize bearings are always used with reground crankshafts, and in regrinding it is often necessary to touch up or true up the thrust collars on the crankshaft journal. The length of the journal is thus increased, and it is to compensate for this greater length, which increases with the number of regrinds, that the bearings are made with fitting stock on the thrust faces.

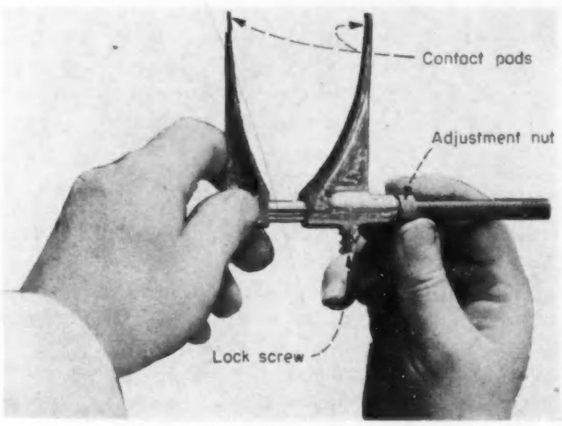
In ordering undersize flanged thrust bearings or standard-diameter thrust bearings which are used in locations other than the front or No. 1 location, and which are to be rebored from semi-finished stock, it is necessary to specify the length (in inches and thousandths of an inch) between the crankshaft thrust collars as shown in Fig. 9.

Local conditions may sometimes make it impossible to furnish bearings to the exact length required. In this event, the bearing flange faces must be scraped to fit at assembly.

When the thrust bearing is located at the front of the engine, means of end-clearance adjustment are always provided; and it is not necessary to hold the bearing length to the close limits required in a location where no adjustment is possible.

Recommended Crankshaft End Clearance At Thrust Bearing

Crankshaft Journal Diameter, in.	Recommended Crankshaft End Clearance, in.
2 to 2¾	0.004 to 0.006
2 13/16 to 3½	0.006 to 0.008
Over 3½	0.008 to 0.010



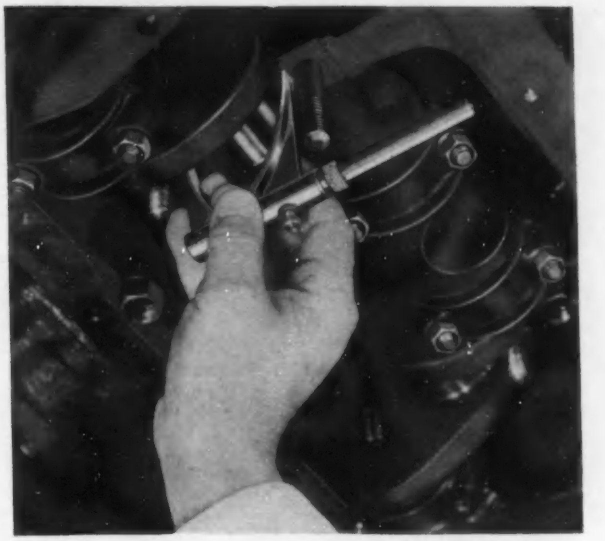
■ Fig. 10 – Crankshaft caliper

■ Faulty Main Bearings

When a connecting-rod bearing failure occurs, do not stop with its replacement. Investigate the conditions of its adjacent main bearings. The main bearing which supplies the rod bearing with oil may be so badly worn or broken up that it cannot retain oil and the rod is starved of lubrication.

■ Crankshaft

Replacement main bearings are frequently installed without removing the crankshaft from the engine, and since it is impossible in most engines to reach the crankshaft journals with a conventional micrometer, the determination of the journal size and bearing diameter has often been largely a matter of guesswork. This guesswork can be eliminated by the use of the special crankshaft caliper shown in Fig. 10.



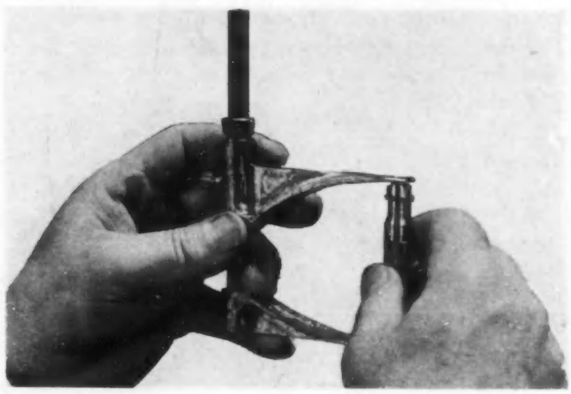
■ Fig. 11 – Obtaining size of crankshaft journal

This caliper is suitable for use in all engines in which the main bearings can be removed and replaced without disassembling the crankshaft. With the old bearings rolled out, it is possible to reach in with the caliper and obtain the journal size as shown by Fig. 11.

The actual dimension is finally taken with an inside micrometer as shown in Fig. 12. Take measurements at enough points on each journal to find the largest diameter and to establish the amount of wear and associated out-of-roundness.

Crankpin sizes can easily be obtained with the crankshaft caliper or with outside micrometers. It is absolutely necessary that the crankshaft journal and crankpin sizes be accurately established so that replacement bearings can be supplied which will have the correct oil clearance. If the crankshaft is out-of-round, bearings must be obtained which will have proper clearance over the largest diameter.

However, as a general rule, if the main journals are more than 0.003 in. out-of-round and the crankpins more than 0.002 in., the shaft is unfit for further use and must be reground. These out-of-roundness values are selected

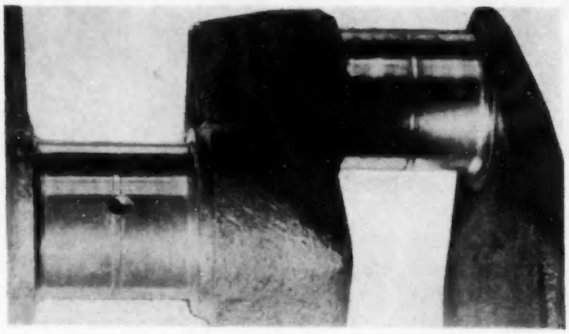


■ Fig. 12 – Measuring distance between contact pads on crankshaft caliper with inside micrometer

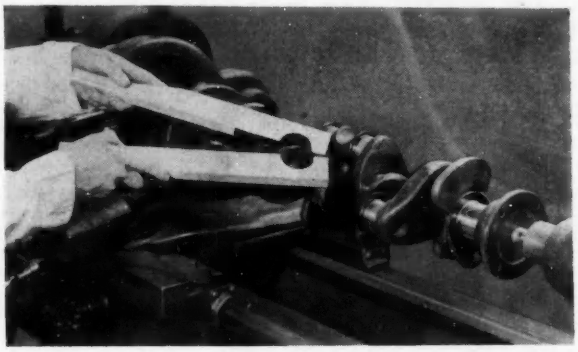
as a compromise between the ideal condition of true roundness with associated maximum bearing mileage. Certain engine manufacturers recommend regrinding when out-of-roundness of 0.0015 in. exists. Bearings will last longer with truly round journals and crankpins than if out-of-roundness in any amount exists.

The installation of new bearings with an out-of-round crankshaft must be considered as an emergency repair, and full mileage cannot be expected from the bearings.

A crankshaft which is worn to the extent that the bearing surfaces are ridged and scored, as shown in Fig. 13, is unfit for use and must be reground.



▪ Fig. 13 – Crankshaft journal and crankpin badly worn and ridged – shaft must be reground



▪ Fig. 14 – Hinged crankshaft lapping stick for use with polishing cloth

After regrinding, the ground surfaces must be finally lapped and polished to obtain a satisfactory smooth finish. A ground finish only is considered too rough, and will result in a high rate of both shaft and bearing wear.

The polishing set-up between centers shown in Fig. 14 has been successfully used for many years in certain engine manufacturing plants.

A number of different polishing cloths have given satisfaction – viz: Electro-Coated Lightning Metalite Cloth (Behr-Manning) in No. 240 grit for roughing, No. 320 for polishing, Three-Mite No. 120 grit (Minnesota Mining Co.), and others.

The polishing cloth must be thoroughly wetted with engine oil.

The lapped surfaces are sufficiently smooth if a piece of sheet copper (or a copper penny) can be scraped back and forth across the surface to be tested parallel with the centerline of the shaft, without leaving traces of copper on the steel surface. The crankshaft surfaces must be completely dry and free from oil when this test is made.

After grinding and polishing, the crankshaft must be washed and all internal oilways *thoroughly* cleaned out.

The crankshaft must be in true alignment, and free from warpage and distortion. The journals are readily checked for alignment in "V" blocks, and a dial indicator is used for determining if the shaft is true (see Fig. 15).

With the set-up as shown, the center or intermediate bearings should show an indicator reading of not more than 0.003 in. For testing either front or rear main journals, one of the "V" blocks is moved to the center. The same error is permissible for either of the end bearings as is allowed for the center. The shaft should be protected from scratches while being turned in the blocks by a strip of paper laid in the "Vee's."

▪ Crankcase and Bearing Cap Assembly

For use with precision insert (interchangeable) main bearings, the crankcase-bearing saddle bores must be round within 0.002 in. and in true alignment lengthwise. If the crankcase has become bowed so that the centerline of the main-bearing saddle bores corresponds to the warped centerline *B*, Fig. 16 (which is shown exaggerated), a straight crankshaft will be thrown out of alignment, and heavy and false loads imposed upon the main bearings, particularly toward the center of the crankcase. The crankcase-bearing saddle bores are in correct alignment when an "aligning bar" (which extends the full length of the case), ground 0.00075 in. under the case bore diameter, can be turned by hand with the aid of a 15-in. pipe extension (or wrench) after the caps are tightened down over the bar.

If the saddle bores are out-of-round in excess of 0.002 in. and the crankcase is excessively bowed as described, precision insert (interchangeable) bearings should *not* be used if maximum bearing mileage is expected. *The main bearings should be align bored in the crankcase so that the discrepancies can be compensated for.*

The align-bored finish must be smooth, as obtained with a 0.002-in. feed per revolution using a tool bit having a 90 deg nose with the sharp point stoned off.

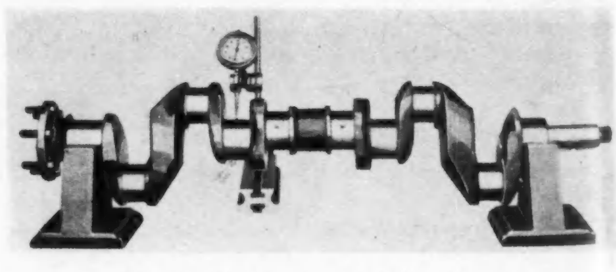
Tighten all main bearing bolts and nuts with a torque wrench to uniform settings – as specified by the engine manufacturer or torque wrench manufacturer.

Avoid cap misalignment sidewise by using wrench sockets of the proper diameter.

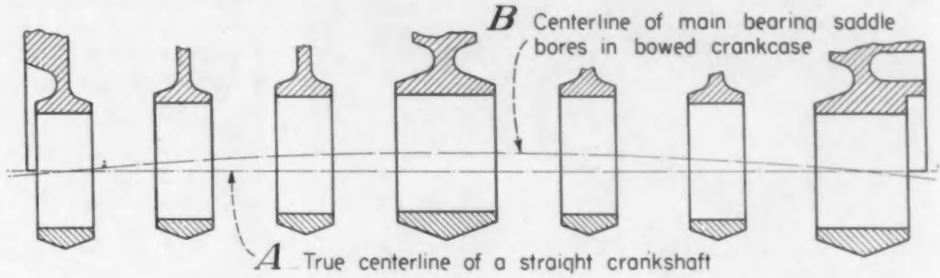
▪ Connecting Rods

Accurate engine reconditioning demands careful aligning of the connecting rods.

As defined in Fig. 17, the crankpin-bearing bore and



▪ Fig. 15 – Checking crankshaft for alignment



■ Fig. 16 – Diagram of a bowed crankcase

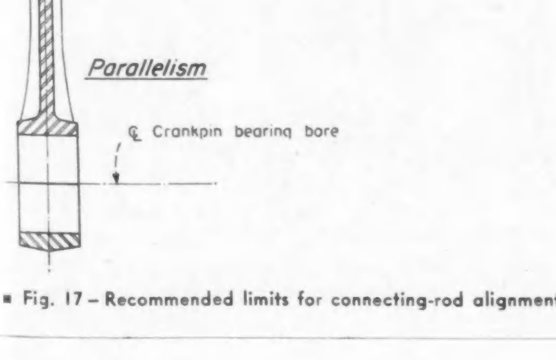
the piston-pin-bushing bore must be parallel with each other within 0.001 in. in 6 in., and the twist between these bores must not exceed 0.001 in. in 6 in.

In maintaining correct connecting-rod alignment, the object is to have the piston gliding surface truly square with the connecting-rod bore. Misaligned connecting rods with pistons out-of-square with respect to the rod bore, impose high false loads not only on the connecting-rod bearings but on the piston skirts and cylinder walls. They cause engine knocks, oil pumping, and blowby, because the faces of the piston rings are held at an angle to the cylinder bore.

A number of fixtures, such as illustrated in Figs. 18 and 19, are commercially available for checking rod and piston alignment. Corrections are usually made by twisting or bending the rod with a notched bar. *Heavy* rods seldom remain aligned after this operation. The steel is not permanently set, and the rod soon returns to its warped condition. It is better to accurately bore the piston-pin bushing to size and in true alignment with the connecting-rod bore, thus eliminating any bending or twisting of the rod.

For use with precision insert (interchangeable) bearings, the connecting-rod bore must be round within 0.002 in.

Connecting-rod bores are quickly and accurately checked for roundness with the special indicator illustrated in Fig. 20.



■ Fig. 17 – Recommended limits for connecting-rod alignment

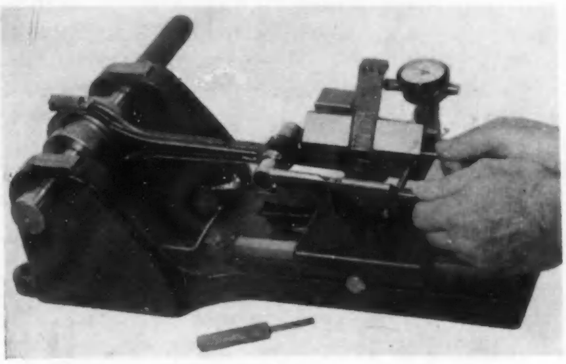
If out-of-roundness in excess of 0.002 in. exists, the rod should be reconditioned, or replaced, or an undersize bearing installed which is *bored to size in the rod* so as to obtain a truly round bearing bore.

■ Inspect the Complete Cooling System

Excessive engine temperatures are damaging, not only to the bearings, but to many other engine parts. The radiator and engine water jackets must be clean and free from deposits of lime and scale which will impede free flow of the cooling water.

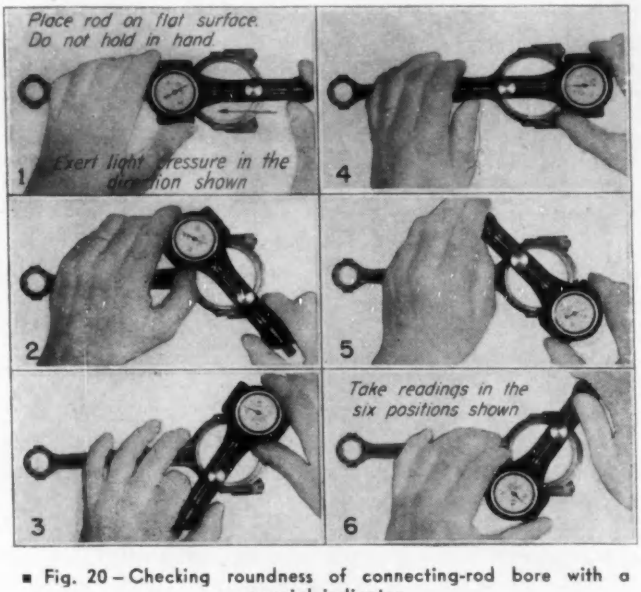
Inspect all water-hose connections. The cut-away specimen in Fig. 21 is badly deteriorated, and the water passage almost closed off. It was removed from an engine which was running too hot and detonating (spark knocking) badly.

Inspect all thermostats in the cooling system. It is particularly dangerous if they are inoperative from the closed



■ Fig. 18 – Checking piston-pin parallelism and twist

■ Fig. 19 – Checking squareness of piston skirt with connecting-rod bore



▪ Fig. 20 – Checking roundness of connecting-rod bore with a special indicator

▪ Fig. 21 – Water-hose connection from an overheating engine

position – a cracked block or head will almost certainly result.

It is obvious that leakage at the water-pump packings must be corrected.

▪ Check Intake-Valve Stems and Guides

Excessive clearance of the intake-valve stems in their guides will induce heavy oil loss (see Fig. 22). If intake-valve stems or guides are worn, the vacuum created on the intake stroke of the piston draws excessive amounts of oil and air through this channel into the combustion chamber.

Oil passing the intake-valve guides can easily be detected, because inspection of the intake valve will reveal a heavy deposit of carbon or soot on the underside of the head.

This condition can be corrected by the installation of valve-stem packing or the replacement of intake valves and their guides.

Excessive air drawn through worn intake-valve guides disturbs carburetion of the engine and affects its idling.

▪ The Pistons, Rings, and Cylinder Bores

It is obviously necessary that pistons, rings, cylinder bores or liners, valves, and valve seats must be in good condition if maximum engine performance is to be obtained. It is not within the scope of this work to go into greater detail concerning these parts.

However, it is well to note that if cylinder bores or liners have been reground, they must be true and square with the axis of the crankcase-bearing saddle bores. Out-of-squareness of the cylinder bores is just as harmful to the connecting-rod bearings and pistons as a bent connecting rod.

▪ Engines Must Be Kept Clean

Dirt is the No. 1 enemy of bearings and engines. A satisfactorily clean engine *cannot* be obtained by passing flushing oil through it after the job is completely and finally assembled. Engine cleanliness must start with a clean shop and orderly surroundings.

In a complete teardown and overhaul, all metal parts, such as cylinder blocks, crankcases, gears, connecting rods, oil pans, and so on, must be thoroughly washed. Clean parts are more convenient to handle and possible defects, such as cracked valve seats, water jackets, and so on, are easier to detect. If dirty parts are assembled into an engine, trouble will surely follow.

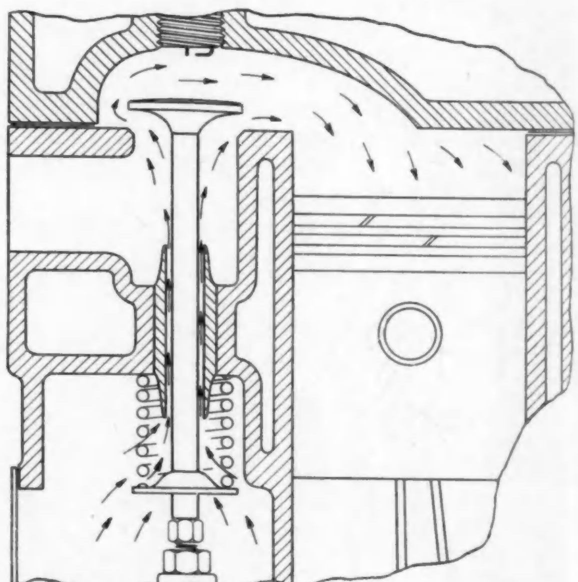
A number of efficient cleaning methods and materials are offered by specialists in the mechanical cleaning field. Included in these methods are immersion of the parts in tanks containing hot-water solutions of suitable solvents, the use of *vapor degreaser* equipment, steam jets, and so on. (Reference: Oakite Products, New York, Detroit Rex Products Co., Detroit, and others.)

Clean surfaces are readily obtained. It is usually necessary to apply a coating of oil to bright-finished parts just as soon as they are dry, to prevent rusting.

It is not sufficient that the cylinder block was thoroughly cleaned before the operations of valve grinding and cylinder grinding. It must be thoroughly cleaned *afterwards* as well, to remove all abrasive residue from these operations.

Crankshaft oilways (see Fig. 23) and drilled oil passages within the cylinder and crankcase must be carefully swabbed and flushed out, preferably with kerosene or a special flushing oil.

If blown out with an air hose, watch that the dirt does not befoul and contaminate adjacent clean parts which are



▪ Fig. 22 – Oil is drawn through worn intake-valve guides into the combustion chamber on intake stroke of piston

ready for assembly. An air hose, carelessly used, can be a dangerous implement by blasting filth over everything within range.

Obviously, work benches and machine equipment must be kept clean and orderly.

The use of an "oil pressure loss indicator" tank as a final check for bearing clearance provides added insurance against dirty bearings, as the flow of oil under pressure will flush out all oilways and bearings before the crankshaft turns over under power.

It is often necessary to clean out the interior of an engine independently of a complete teardown and overhaul. Efficient flushing compounds and flushing oils are readily available and their use can be recommended – *if proper care and judgment are used.*

A part of the flushing procedure usually is to run the engine at idling speed for 45 to 60 min or more, so that the flushing agent can penetrate and loosen the deposits.

If the engine interior is badly sludged and dirty, large quantities of loosened deposits will be collected in the oil pan.

These settlings, in excessive quantity, may tangle themselves in the oil-suction screen to the extent of partially or completely clogging it. Watch the oil gage pressure carefully at this time. If the pressure drops off, it is an indication that the suction screen is clogged and oil is not getting through the system. Stop the engine, remove the oil pan, clean things up, and start over.

Drain while the engine is still warm as the mixture will flow more freely. Remember that the location of the drain in most oil pans is such that approximately one pint of old oil always remains to contaminate the new.

If the engine interior has been choked up with filth, *remove the oil pan after the flushing operation* so that it can be thoroughly cleaned out. Inspect and thoroughly clean the oil-suction screen, make sure that the interior of the oil filter is clean and install a fresh oil-filter cartridge. Then hook up an oil pressure loss indicator tank and finally flush out the system, using the flushing oil selected with the detector tank set for 30 lb or more gage pressure.

Don't wait until an engine interior is choked up with sludge and wall deposits. There are many hazards connected with trying to clean it out without complete dismantling.

Oil changes at suitable intervals, depending on the type of operation, will usually keep an engine clean.

Interior flushing at 15,000- to 20,000-mile intervals is desirable, and this should start after the first 15,000 or 20,000 miles.

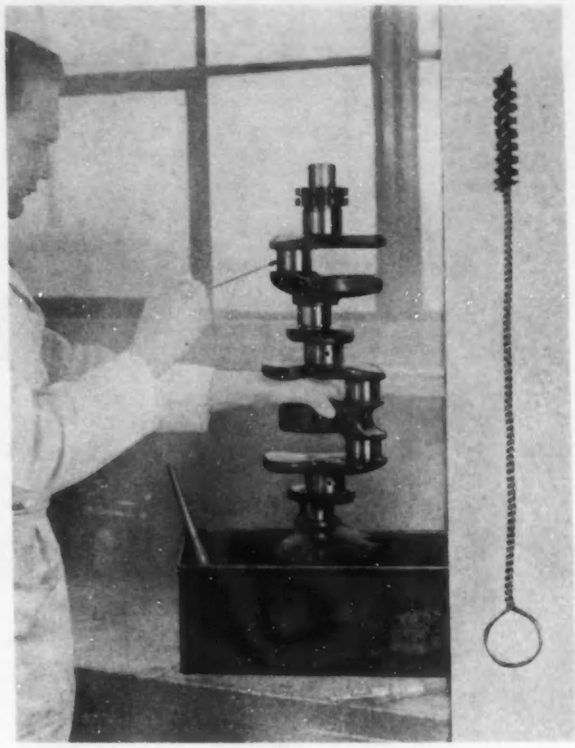
■ Attend to the Oil Filter

Thoroughly clean the oil filter, replacing the filter cartridge, and attend to whatever other points of maintenance are required for the particular type of unit used.

A clean and efficient oil filter is a necessity if maximum bearing life is to be obtained.

■ Attend to the Air Cleaner

Thoroughly cleanse the carburetor air cleaner. At high speeds, several hundred cubic feet of air per minute are drawn into the engine and may be contaminated with heavy quantities of abrasive dust, which causes excessive wear of all moving engine parts. This air must be purified. A clean and efficient air cleaner is of real help in obtaining long bearing and engine life.



■ Fig. 23 – Cleaning a crankshaft oilway with a small wire brush

■ Inspect the Vacuum Booster Pump

Certain engines are equipped with a vacuum booster pump to provide sufficient vacuum (power) to operate the windshield wiper when the throttle is open.

If the diaphragm in this pump (see Fig. 24) is cracked, punctured, or porous, oil may be drawn directly from the pump into the intake manifold causing a smoky exhaust and excessive oil consumption.

To check the condition of the booster pump, accelerate the engine and watch the action of the wiper blade. If the blade stops, it is an indication of a defective diaphragm.

A positive check is to disconnect the vacuum line and run the engine several minutes. If smoke at the exhaust ceases, it indicates a defective diaphragm which must be replaced.

■ Bearing Spread

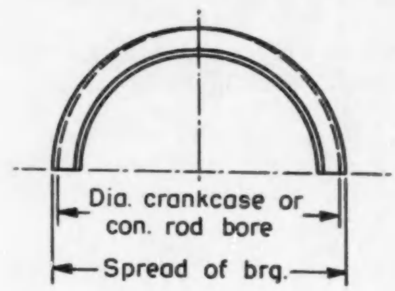
Most split main and connecting-rod bearings are purposely made with the "spread" (width across the open ends) slightly greater than the diameter of the crankcase or connecting-rod bore in which they are assembled (see Fig. 25).

The amount by which the spread dimension exceeds the case or rod bore diameter will range between 0.005 and 0.020 in., depending on the thickness and structural stiffness of the bearing. The bearing must thus be snapped or lightly forced into its seat at assembly, and it will remain in place during subsequent assembly operations when the caps are handled upside down.

The Ford V-8 floating connecting-rod bearings (all models) are exceptions to the general rule that the width across the open ends *should* be greater than the rod-bore diameter.

Any split bearing is relatively fragile and unstable struc-

■ Fig. 24 – Combination fuel pump and vacuum booster pump (from demonstrator model)



■ Fig. 25 – Diagram showing "spread" in a split bearing

turally, and it sometimes happens that due to rough handling in shipment or storage and certain other natural phenomena, these bearings increase in width across the open ends so that they are slightly wider than the rod bore.

In the Ford rod bearings, it is *preferable* that they be truly round and smaller at every point in the circumference than the rod bore, but nevertheless a certain amount of excess width is permissible without damage, even though the rods may feel somewhat tight when assembled over the bearing.

The correct distance across the open ends of the various Ford connecting-rod bearings as taken from original equipment specifications is shown in Fig. 26.

Excessive "spread" in any bearing is readily corrected as follows:

Hold bearing on a smooth block, as shown in Fig. 27 and strike the side lightly with a soft mallet. Continue until the correct width is obtained.

If, during this operation, the width is decreased to a point less than it should be, it can be increased again by laying the bearing on the wood block, as shown in Fig. 28, and striking the back lightly with the soft mallet.

The spread of any bearing can be safely adjusted by this method.

■ Check the Camshaft Bearings

Worn camshaft bearings, if pressure lubricated, are often responsible for puzzling cases of lack of oil pressure and high oil consumption. Excessive oil leakage can occur at worn camshaft bearings just the same as at worn mains and rods. Cam bearing wear is considerably slower, but after an engine has used up two sets of main and connecting-rod bearings, the cam bearings are a potential source of trouble due to wear.

Worn camshaft bearings are easily located by the use of an oil pressure loss indicator tank.

■ Provide Correct Oil Clearance

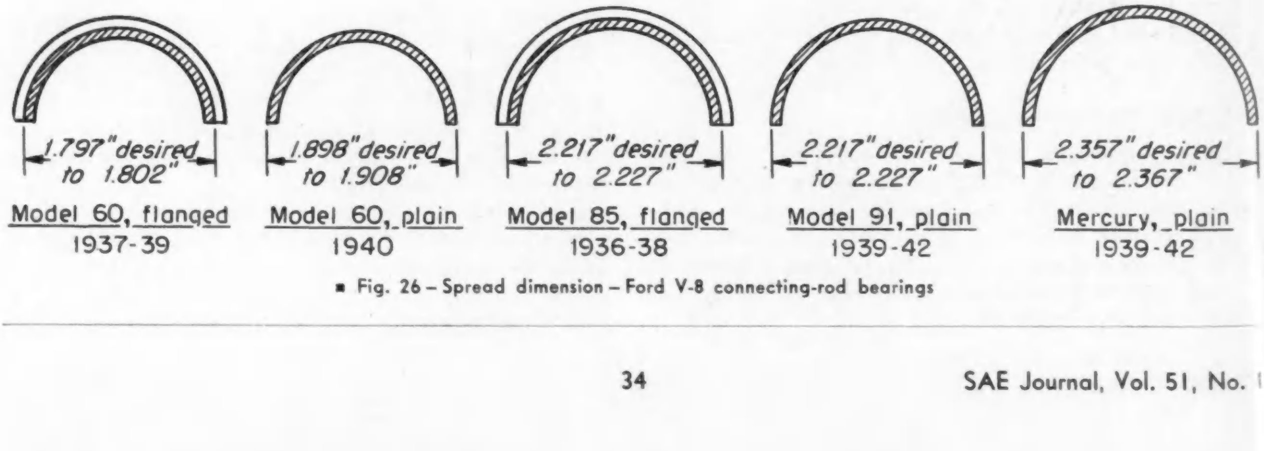
Any heavily loaded engine bearing must be separated from its shaft by an oil film. Space must, therefore, be provided between shaft and bearing in which this film can form.

Since the rotating shaft creates a considerable amount of frictional heat, this clearance space must be sufficient to allow oil flow through the bearings, so that cool oil is constantly replacing that which has been heated.

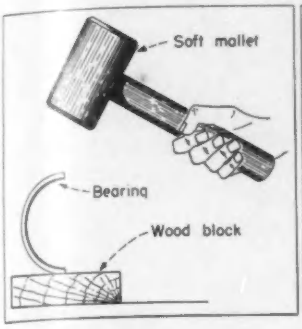
Oil not only lubricates, it cools the bearing as well, and one function is just about as important as the other.

If the oil clearance is too small, many troubles arise, such as wiped bearings, worn crankshafts, excessive cylinder wear, scuffed piston rings, worn pistons, and so on.

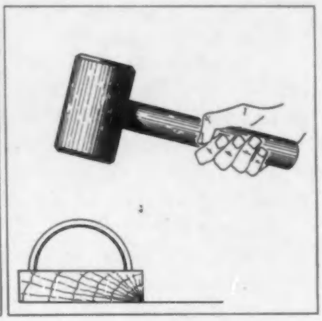
If the oil clearance is too great, another series of ailments will develop.



■ Fig. 26 – Spread dimension – Ford V-8 connecting-rod bearings



■ Fig. 27 – Reducing spread of bearing



■ Fig. 28 – Increasing spread of bearing

The increasing use of precision insert main and connecting-rod bearings considerably reduces the difficulty of obtaining correct oil clearance *if* the crankshaft is finished to proper *decimal dimensions,* and the crankcase and connecting-rod bores are round and true to dimensions as originally manufactured.

However, many bearings must be locally align bored or otherwise sized to fit the crankshaft, and the accuracy of the oil clearance must be carefully attended to.

Recommended oil clearances for various types of bearings are shown in Fig. 29.

To obtain the clearances specified, it is assumed that the crankshaft diameters will be accurately obtained by micrometer measurement and the bearings accurately bored to suit, also by micrometer measurement. However, it is necessary to check the clearance after the various machining operations, and for this purpose the use of brass shim stock of the correct thickness has been very successful.

In using this material, care must be exercised to avoid damaging the bearing. The length of the shim stock gage should be approximately ¼ in. less than the length of the bearing and ¼ in. wide. It is desirable that the edges be smoothed down on an oil stone so that no sharp, turned-over corners will remain to embed themselves in the soft bearing material.

Place cylinder block in an inverted position as shown in Fig. 30.

Start at center bearing or one of the intermediates, in a four-bearing engine.

Coat feeler lightly with engine oil on both sides.

Place feeler of correct thickness (and made as previously described) on crankshaft journal, as shown in Fig. 30, assemble and tighten down cap and lower half bearing. With the assembled crankshaft grasped as shown in Fig. 31, rotate same through an arc of 2 in. – 1 in. each way.

Dia Crankshaft Journal or Crankpin	Clearance in inches *Tin Base Babbitt* or *High Lead Babbitt*	Clearance in inches *Cadmium Silver Copper*	Clearance in inches *Copper Lead*
2 to 2¾	0015	.0020	.0025
2 13/16 to 3½	.0025	.0030	0035
3 9/16 to 4	.0030	.0035	.0040

Note a: *A tolerance of plus .001" is allowable on the clearances specified.*

Note b: *Oil clearance as shown in this chart is the difference in the diameter of the crankshaft journal or crankpin and the bore diameter of the bearing.*

■ Fig. 29 – Table of recommended oil clearances for various types of engine main and connecting-rod bearings – for pressure (force-feed) lubrication

With the feeler in place, the shaft should be movable with a fairly heavy drag.

Remove feeler, replace cap, *but do not tighten;* this check must be made with the cap and bearing over the feeler only, tightened down. The remaining caps should be loosely in place.

Repeat the operation next at the rear bearing – then at the intermediates.

Make sure that ends of bearings do not ride the crankshaft journal fillets.

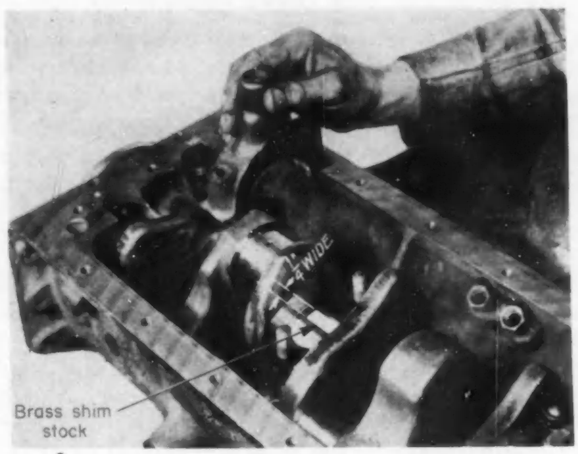
If desired, the feeler may be made from cigarette papers which measure from 0.0008- to 0.0016-in. thickness. Use one or more to obtain required thickness.

■ Provide Correct End Clearance

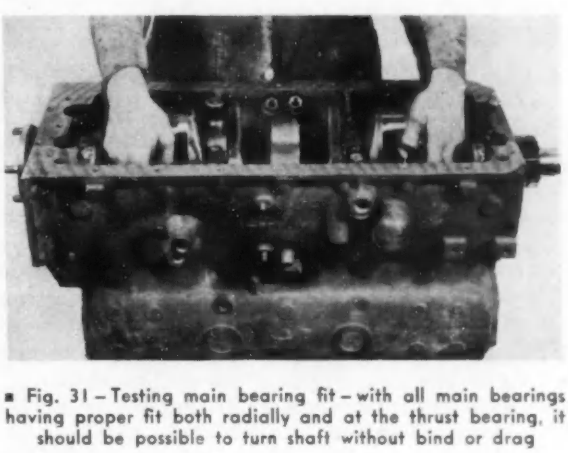
It is important that proper crankshaft end clearance (end play) be provided at the thrust bearing.

End clearances are recommended as shown in Fig. 32.

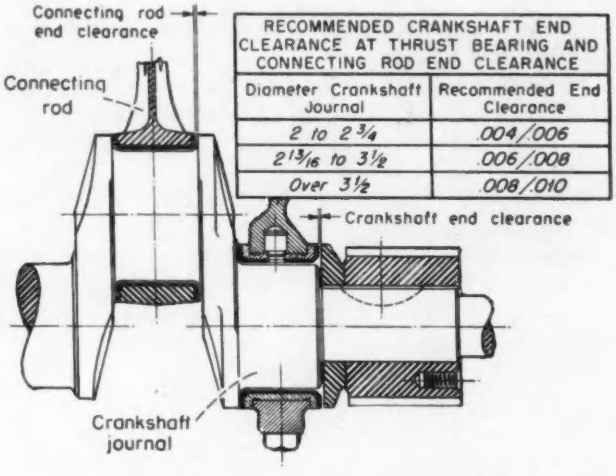
End play should be checked with a feeler (see Fig. 33), and with the crankshaft pried as far as possible either to the front or the rear – whichever is more convenient on the particular engine, since the thrust may be taken at the front, center, or rear bearing – depending on the make of engine. With the thrust collar on the crankshaft in contact with the thrust surface of the bearing at one end, the



■ Fig. 30 – Checking oil clearance with feeler made from brass shim stock – feeler is applied between crankshaft and bearing



■ Fig. 31 – Testing main bearing fit – with all main bearings having proper fit both radially and at the thrust bearing, it should be possible to turn shaft without bind or drag



RECOMMENDED CRANKSHAFT END CLEARANCE AT THRUST BEARING AND CONNECTING ROD END CLEARANCE	
Diameter Crankshaft Journal	Recommended End Clearance
2 to 2 3/4	.004/.006
2 13/16 to 3 1/2	.006/.008
Over 3 1/2	.008/.010

■ Fig. 32 – Recommended crankshaft end clearance at thrust bearing and connecting-rod end clearance

total clearance is readily measured with a feeler at the other end. Check the clearance at several points around the bearing flange. Remember that one bearing only in the line should take thrust of the crankshaft, and the other bearings should have ample clearance at each end.

■ Use of Torque Indicating Wrench

The excessive tightening of studs, nuts, and capscrews in an engine will harmfully distort cylinder heads, cylinder blocks, connecting-rod bores, crankcase main bearing bores and many other parts. Studs and capscrews may be strained and stretched to the point that failure will occur in service.

In all engine manufacturing plants, torque indicating wrenches are used to insure that nuts and capscrews are correctly and uniformly tightened.

Thus, when the crankcase-bearing saddle bores and the connecting-rod bores are originally machined, the cap bolts or nuts have been tightened to a specified reading on a torque indicating wrench. The bores are exactly *round* under the specified condition of bolt tightness, but if the bolts are drawn down tighter or if they are not as tight as the original setting, the crankcase and rod bores will not be truly round, and bearing life will suffer.

Accurate bearing replacement cannot be made without the use of a similar "measuring" wrench which will make it possible to duplicate factory assembly conditions.

■ Points in Bearing Assembly

1. Wipe backs of bearings, also the crankcase, bearing cap, and rod bores to remove dirt particles at the time each individual bearing shell is placed in its seat. If shims are used, wipe off each one individually.

2. Inspect for burrs in crankcase, caps, rod, and on bearings, which would interfere with proper seating of the bearings.

3. Light-wall steel-back bearings are located endwise, and retained against turning by a lip stamped out from the steel back. At assembly these lips must be carefully and completely nested in the slots provided for them in the crankcase, bearing caps, and connecting rod.

4. Make sure the main bearing and connecting-rod caps are not misplaced endwise or sidewise at assembly.

5. Bolt the caps on lightly. Tap them at the crown to centralize; then tighten.

6. Never place shim stock between the back of the bearing shell and its seat to obtain greater bearing height or to close in a worn bearing for a better fit over the shaft.

Air spaces are formed which retard the transfer of heat to cooler parts of the engine; this heat at the bearing lining builds up, and early failure results.

7. Many mechanics have attempted to make adjustments with precision insert (interchangeable) bearings by filing the contact surface of the bearing cap. This is poor practice. Bearings are short-lived, the roundness of the crankcase and bearing cap bore is destroyed and the installation of new bearings, when this is finally done, is greatly complicated.

■ Special Points in Align Boring

1. After bearings, shims (if used), and caps are properly assembled, plug all oil ways with small but substantial pieces of clean rag to prevent chips and borings from getting into the lubricating system (see Fig. 34).

2. In locating the boring bar, great care must be exercised to insure that the centerline of the finished bearings will be the correct distance from the top of the cylinder block, parallel with it, and at right angles to the cylinder

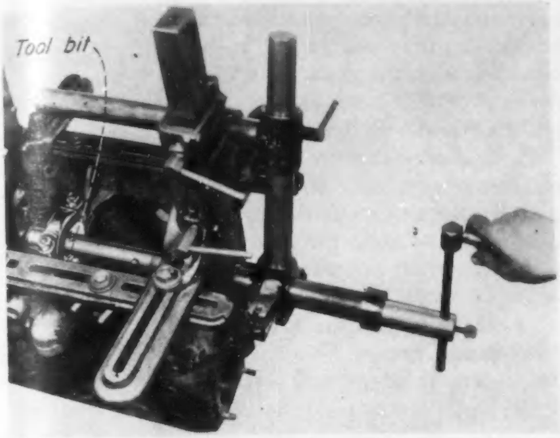
■ Fig. 33 – Checking crankshaft end clearance

bores. In an engine built with a gear drive to the camshaft (see Fig. 35), the distance between the centerline of the camshaft and its bearings, and the bore of the main bearings must be very accurately maintained so that the crankshaft and camshaft drive gears will mesh properly. A little more leeway is permissible if the camshaft is driven by a chain.

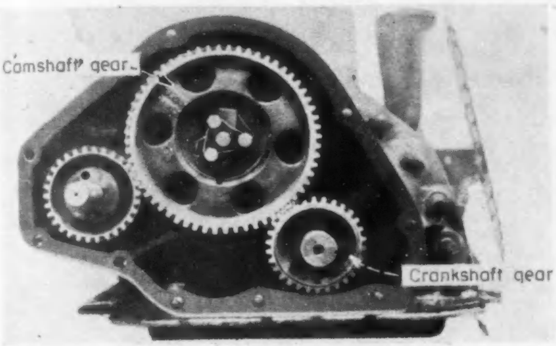
3. After all boring and thrust bearing facing (see Fig. 36) operations are completed, be sure to remove all plugs from the oilways and *all* chips from the interior of the crankcase.

■ Assembling Main Bearings

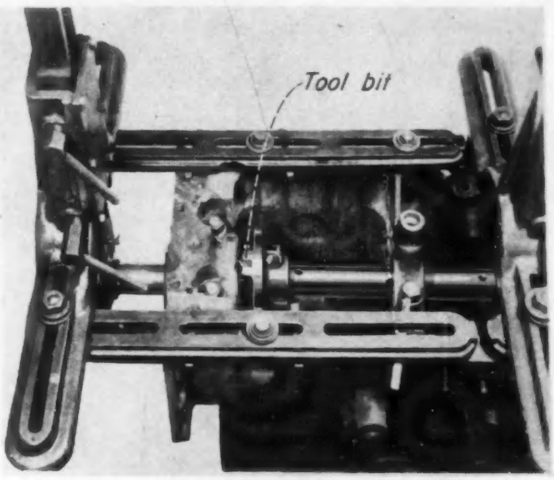
In certain engines employing precision insert bearings, it is possible *in an emergency* to remove and replace an upper main-bearing shell without removing the crankshaft. The bearing may be light-wall steel back with the locking lip on one side, or heavy-wall steel or bronze back, in which no dowel is used in the upper shell.



■ Fig. 34 – Align boring main bearings



■ Fig. 35 – Main bearings must be bored in correct relation to camshaft center so that timing gears will mesh properly



■ Fig. 36 – Set-up for facing thrust bearing

To remove a bearing of this character from the engine, remove the cap at the bearing involved, and back off all the other caps slightly so that the shaft is entirely free from the upper bearings. A special headed plug in steel or bronze of the general design shown in Fig. 37 is then inserted in the crankshaft oilway, and the shaft rotated until the extended end of the plug is in contact with the bearing on the side *opposite* the locking lip. Turning the crankshaft carefully in a direction towards the locking lip will rotate the bearing from its position in the crankcase.

To install a new upper bearing, the crankshaft must be turned in the opposite direction to that used when the old bearing was removed. Place the new bearing on the crankshaft journal with the plain edge ready to enter the space between shaft and crankcase bore on the side of the crankcase bore which is milled to receive the bearing locking lip. Make a careful visual alignment of the bearing locking lip and its slot in the crankcase when the bearing is placed on the shaft so that as the bearing is rotated into position, the lip will nest properly in its slot without binding. If the lip binds on the side of the crankcase slot, the bearing surface will probably be harmfully distorted and disturbed.

If the bearing to be removed is a heavy-wall type without a dowel, turn the crankshaft in a clockwise direction (looking from front of engine). To install the new bearing, turn the crankshaft counter-clockwise.

As explained previously, all bearings are made with a certain amount of spread across the open ends. In heavy-wall bearings this spread may cause some difficulty when it is attempted to make a bearing installation as described without removing the crankshaft. In this event, round up the bearing as shown in Fig. 27.

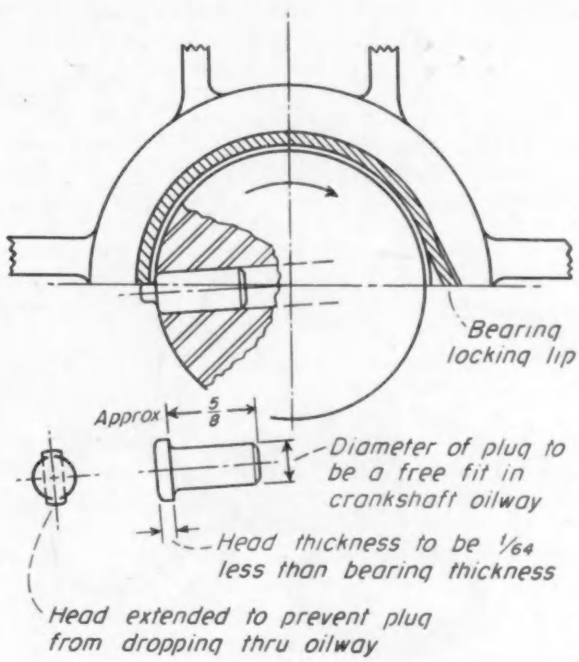
This type of bearing replacement is an emergency measure only. The work is done "blind" and there are many chances for error. Be sure that the crankshaft journal, crankcase bore, and bearing back are wiped clean.

■ Replace Gaskets and Check Oil Seals

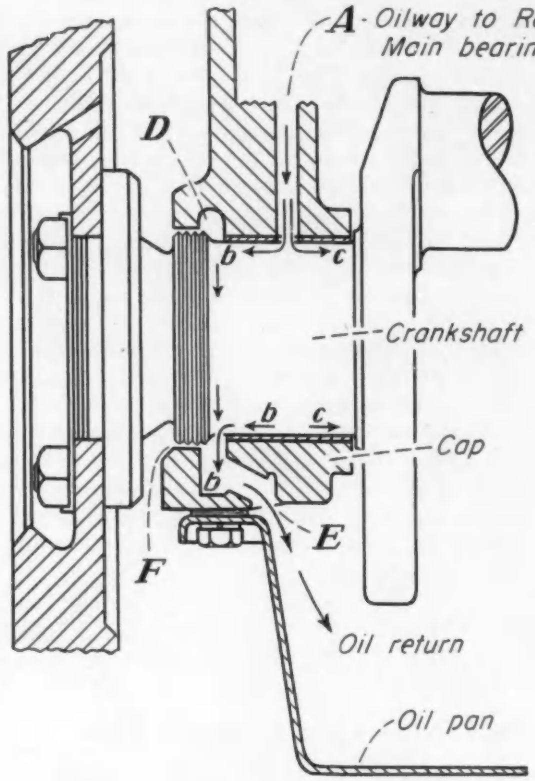
To prevent unnecessary oil loss, replace the gaskets at all parts which have been removed: oil pan, valve chamber cover, gear or chain case cover, and so on.

Front main bearing oil seals must be in perfect condition.

Rear main bearing oil seals and the surrounding gaskets must be in perfect condition. Oil leakage at the rear main bearing is a fairly common ailment.



■ Fig. 37 – Removing upper main bearing shell by means of a special headed plug inserted in crankshaft oilway



■ Fig. 38 – Typical construction at a rear main bearing

Oil often has a tendency to work past this bearing and through the sealing mechanism because of a "sucking" action of the rotating flywheel at high engine speeds.

Leakage is aggravated if abnormal "blowby" of compression and explosion past the piston rings exists, as this creates a certain amount of pressure within the crankcase which forces oil and oil-laden vapors out of all openings in the crankcase.

The construction at and adjacent to a typical rear main bearing basically follows Fig. 38.

Oil enters the bearing through drilled oilway *A*. When it reaches the crankshaft, the flow is toward both ends of the bearings following arrows *b* and *c*. Oil flowing toward the rear (arrows *b*) is stopped at the interrupter groove or channel at *D* in the crankcase and bearing cap. Oil which reaches groove *D* is supposed to drain back into the oil pan through orifice *E* in the bearing cap.

When blowby pressure exists within the crankcase, the opening to the outside atmosphere through the rear main bearing is one of the most natural avenues of escape. This pressure acts upwards through the oil drain orifice *E* into the groove at *D* and escapes into the flywheel or clutch housing through the clearance space between the crankcase (and bearing cap) and the crankshaft at *F*. Since orifice *E* and groove *D* are partially filled with oil, the escaping crankcase pressure carries oil along with it.

High crankcase pressure causing front and rear main bearing oil leakage will be built up if the oil filler cap and ventilator tube are clogged or obstructed.

Excessive clearance at the bearing will allow more oil to flow through the bearing than can be controlled by the sealing construction.

■ Uses of Pressure Loss Tank

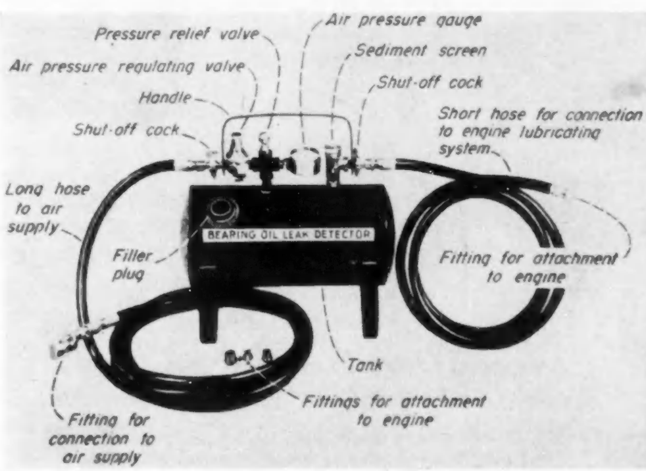
These devices (see Fig. 39) consist of a tank holding several quarts of *clean* oil under air pressure obtained from a convenient source. The air pressure within the tank is uniformly controlled by a pressure regulator which can be adjusted to match the engine oil pressure. In operation, the dash oil gage line is disconnected at the engine and the hose leading to the tank is connected up.

With the oil pan removed, oil under pressure is admitted to the engine, and leakage at the main bearings can be observed. It is usually necessary to re-position the crankshaft for each bearing so that the leakage from the bearing under observation can be properly segregated and not confused with the leakage from another point.

Instructions are furnished with the various tanks to enable the operator to determine if the oil flow through the bearing as observed in the form of end leakage is correct.

In general, if there is no oil leakage at the ends of a bearing, that bearing is fitted too tightly or there is an obstruction in its oil supply. If the leakage exists in the form of a large solid stream, there is excessive clearance or the bearing is badly worn.

These devices are most valuable for locating faulty main,



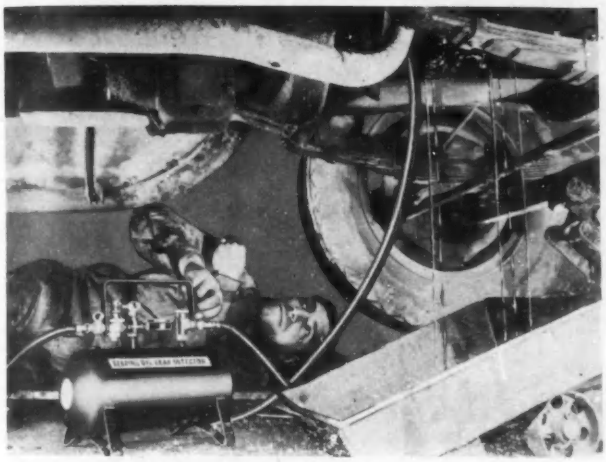
■ Fig. 39 – Typical bearing oil pressure loss indicators

connecting-rod and camshaft bearings in pressure-lubricated engines (Pontiac excepted), also points of leakage due to breaks or cracks in main oil header or other internal oil lines *before* the engine is dismantled. They are of equal value in obtaining a final check on a bearing replacement job.

When used as the final check for oil flow through newly installed bearings, a further advantage is obtained in that the bearings are completely prelubricated before the engine turns over under its own power and dirt or other foreign particles which may have remained in the oil passages or bearings will be flushed out.

■ Maintain Correct Oil Pressure

The amount of engine oil pressure is shown by the oil gage and *must be maintained at the point recommended and built in by the engine manufacturer.* Oil pressure which is higher than the engine builder's recommendation is seldom harmful (and also seldom encountered) but low oil pressure is likely to result in inadequate lubrication



■ Fig. 40 – Bearing oil pressure loss indicator

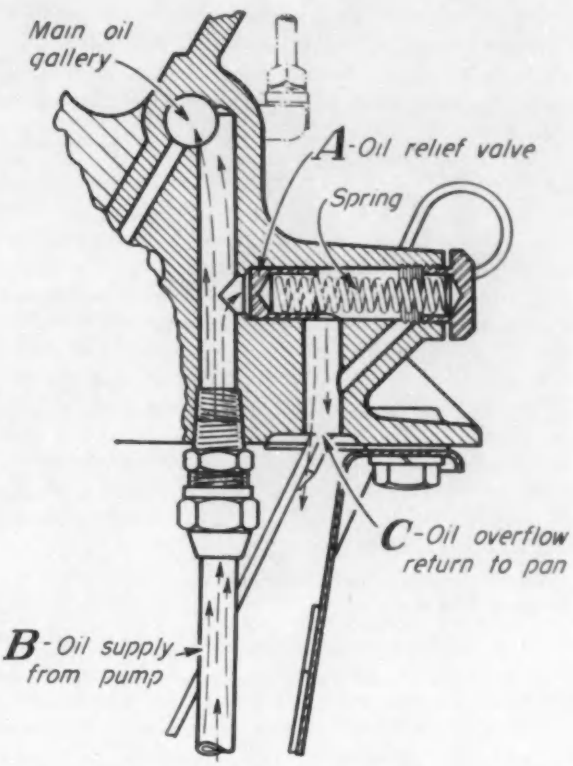
and early failure of new connecting-rod bearings, especially during high-speed operation.

Assuming that all bearings have the correct amount of oil clearance, low oil pressure is usually caused by wear in the oil-pump gears or oil-pump housing, a faulty oil-pump cover gasket and a weakened oil-pressure relief-valve spring. Leakage at breaks or cracks in main oil headers or other internal oil lines is also responsible for reduced oil pressure, but trouble at these points is easily located by the use of a bearing oil pressure loss indicator (see Fig. 40).

■ Normal Pressure Despite Worn Bearings

With a full-pressure engine lubricating system, an oil pressure gage is always connected up with the system. It has been stated previously that badly worn main, rod, and cam bearings will promote high oil consumption and oil loss because of excessive oil throwoff or leakage from the ends of the bearings. The question has been frequently asked, "How can there be excessive oil leakage from worn bearings and subsequent oil pumping from this source if the oil pressure gage registers the normal pressure?"

Another common question has been, "If the car or truck showed, when new, a gage pressure of 40 lb at a given



■ Fig. 41 – Section through typical oil pressure relief valve

speed and if that same pressure is retained later on when high oil consumption has developed, does it indicate that the bearings are not worn and are therefore not involved as a cause of high oil consumption, and do worn bearings lower the oil pressure?"

Any engine will require a definite amount of oil flow per minute at a given pressure to provide adequate lubrication to all moving parts.

If the delivery capacity of the oil pump used on any given engine was exactly equal to the requirements of the engine when new, all of the oil pumped would be delivered to the bearings and other points requiring lubrication.

With such a pump, any increase in bearing clearance due to wear would result in a reduced pressure at the bearings, which would be indicated by a reduced pressure reading on the gage, although exactly the same quantity of oil would be pumped through the engine.

Obviously, an installation of this kind would provide no safety factor, as the reduced pressure might starve the bearings which had not worn excessively, and provide excess oil to the badly worn bearings.

To provide an adequate factor of safety, the oil pump is usually made big enough to supply a great deal more oil than a new engine needs so that when wear occurs there will be oil and pressure in reserve. To prevent the excess oil thus provided from being forced through the bearings, a bypass relief valve is installed in the system as shown at *A* in Fig. 41.

This relief valve is spring-loaded so as to remain closed until a predetermined desired pressure is reached. At this pressure, the excess oil delivered by the pump through the pipe *B* will be bypassed to the oil pan through hole *C* without going through the bearings. Thus, if the oil pump

has 100% greater capacity than is normally required by the engine, one-half of the oil delivered by the pump will be returned to the oil pan through the relief valve.

In such an engine, bearing wear up to a certain point results in more oil being pumped through the bearings and less being bypassed through the relief valve. The gage pressure, however, will remain the same. As soon as a point is reached when the bearing wear is so great that the full pump delivery is forced through the bearing with none being bypassed, then any additional bearing wear will cause a reduction in the gage pressure.

It is thus evident that when the usual large-capacity pump is used, considerable bearing wear may result in excess oil being forced through the bearings and thrown out at the ends without any reduction in the gage pressure. This will obviously induce oil pumping and high oil consumption.

On the other hand, if the pump capacity is very close to the normal requirements of the engine, sometimes a relatively small amount of bearing wear will result in reduced oil pressure gage readings.

■ Engine Break-In

If the instructions for installing bearings as given in this treatise are followed, there will be no tight bearings which will require "running-in." However, the natural antagonism of new raw metal surfaces (such as a newly ground shaft and new bearings) working against each other should be overcome by deep and thorough wetting with lubricating oil.

To obtain this oil wettedness and otherwise condition the bearing surface, use an oil a grade or two lighter for the first 500 miles than the engine builder and oil producer specify for regular operation.

New piston rings, pistons, and refinished cylinder bores will be more sensitive to break-in abuse than the main and connecting-rod bearings. Any break-in procedure recommended for standard or special types of pistons or piston rings will be agreeable to the bearings, if installed as directed.

■ Detonating Engines Destroy Bearings

A "detonating" engine (spark knock, ping) will prematurely destroy its main and connecting-rod bearings. Detonation may be caused by an early spark, a lean carburetor, unsuitable fuel, a hot-running engine (caused by a clogged radiator or water jackets or a late spark), or heavy carbon deposits in the combustion chambers or on the piston heads. An engine must not labor, lug, and detonate at low speed. Shift gears to use a higher engine speed and relieve the strain.

■ Oil and Lubrication

The life blood of an engine is its oil.

Select a good lubricating oil on the basis of competent advice which takes into consideration all features of the engine construction and its type of operation, and *maintain* that oil properly.

It is not a sufficient safeguard that the original filling of oil was of the proper specification and the level maintained by additions of the same oil. The oil must be changed at the intervals recommended by the oil manufacturer in order that it be kept free from harmful contaminants, the most active being those acids which attack certain heavy-duty types of copper-lead and cadmium alloy bearings.

Keep the oil level up to the "full" mark on the gage. A full oil pan means cooler oil.

■ Check List for a Bearing Replacement Job

1. Was the work done by careful mechanics in a clean and orderly shop?

2. Were the correct bearings to suit the engine model installed?

3. Were the crankshaft journals and crankpins round within the required limits?

4. Were the crankshaft journal and crankpin diameters accurately obtained?

5. Were the crankshaft journal and crankpin surfaces smooth and correctly finished?

6. Was the crankshaft in correct alignment and free from bow and distortion?

7. Were the crankshaft oilways clean?

8. Were the crankcase-bearing saddle bores round within the required limits and in correct alignment?

9. Were the connecting-rod bores round within the required limits?

10. Were the connecting-rod bores and piston-pin bushing bores parallel and free from twist within the required limits?

11. Were the radiator, water jackets, water-hose connections, thermostats, water-pump packing, and the cooling system in general, inspected; and are they in good condition?

12. Were the intake-valve stems and guides in good condition to prevent oil loss?

13. Was the engine interior, including all oil passages, thoroughly cleaned before re-assembling?

14. Was the oil filter attended to?

15. Was the air cleaner attended to?

16. Was the vacuum booster pump diaphragm inspected?

17. Was the condition of the cam bearings checked for wear?

18. Did all main and connecting-rod bearings have correct radial oil clearance?

19. Did the crankshaft and connecting-rod bearings have the correct end clearance?

20. Was a torque indicating wrench with the correct settings used in tightening all bolts and nuts; and were the wrench sockets of the proper diameter to avoid pushing caps sidewise?

21. Were all caps assembled in their proper positions and locations?

22. Was the bearing installation finally checked and prelubricated with a suitable bearing oil pressure loss indicator tank?

23. Were all disturbed gaskets replaced?

24. Was a lighter grade of oil used for the first charge after re-assembling?

25. Was the oil pressure normal?

26. Was the engine free from detonation and spark knock?

* * *

Note: In this report, text and illustrations from late publications by Clawson & Bals, Inc., Federal-Mogul Corporation, and Monmouth Products Company have been freely used.

About SAE Members

CHARLES E. NEUMANN has left the Tire Trading Co., Newark, N. J., where he was in the technical sales department, and is now doing private automotive electrical engineering work in Glen Rock, N. J.

Transfer of **A. G. MARSHALL** from manager of technical applications, Shell Oil Co., Inc., Martinez, Calif., to the manufacturing department of the Shell Oil Co., Inc., San Francisco, recently took place.

WESLEY H. TEMMING is no longer engineering draftsman at Engineering Service, Inc., Detroit, having left this position to become a loftsman with the Donnelly Powers Engine Co., Inc., Detroit.

PETER F. HURST is a consulting engineer, Michigan Patents Corp., Jackson, Mich., and general manager of the Concord Mfg. Co., Concord, Mich. Mr. Hurst was formerly general manager of the Aeroquip Corp., Jackson.

ETHAN A. BERRY, who had been assistant general manager of the Chicago Pneumatic Tool Co., Garfield, N. J., is now with the Empire Ordnance Corp., Philadelphia, as engineer.

CURTIS L. MOODY is factory manager of the Dominion Rubber Co., Ltd., Kitchener, Ont., Canada. Mr. Moody formerly held a similar position with the U. S. Rubber Co., Detroit.

Formerly research engineer, Carter Carburetor Corp., St. Louis, Mo., **M. H. KAPPS** is now project engineer in the Detroit Diesel Engine Division of General Motors Corp.

PAUL G. HOFFMAN, president of the Studebaker Corp. and chairman of the Automotive Safety Foundation, on Dec. 8 received the 1942 Bartlett Award from the American Association of State Highway Officials for the year's outstanding contribution to highway progress. The award was made to Mr. Hoffman because of his personal leadership in a broad program vitally affecting highway advancement.

JOSEPH GESCHELIN, Detroit editor, Chilton Publications, and SAE Vice-President for the Production Activity, addressed the annual meeting of the Society of Plastics Engineers in Detroit.

BEN CRAVENS, who had been transportation engineer for the Liebmann Breweries, Inc., Brooklyn, N. Y., is now connected with W. T. Cowan, Inc., Baltimore, as superintendent of transportation.

Formerly tank maintenance engineer, Office of Chief of Ordnance, Washington, **CLARENCE E. MOORE** is now assistant chief of the Technical Tank Unit of the Maintenance Branch of the Ordnance Department, Tank-Automotive Center, Detroit.

J. A. MAHONEY has resigned from the Waukesha Motor Co., where he was sales engineer, and is now connected with the Climax Engineering Co. of Clinton, Iowa, as division manager.

SAE Past-President **A. T. COLWELL,** vice-president of Thompson Aircraft Products Co. and Thompson Products, Inc., gave a radio address for the City Club of Cleveland on Nov. 14, entitled "Our Aircraft Critics – Yesterday, Today, and Tomorrow."

CHARLES W. RIPPIE, formerly petroleum technologist for the Solvay Sales Corp., has joined the Petroleum Chemicals Department, Organic Chemicals Division, Monsanto Chemical Co., St. Louis, Mo., where he will handle technical sales work.

HAROLD R. HARRIS, vice-president of Panagra, has been commissioned a colonel, and will be stationed in Washington as the Plans officer on the staff of the Commanding General of the A.T.C., one of only three who have achieved this rank direct from civilian status.

FELIX DORAN, JR., general manager of the Fleet Division, General Motors Corp., has been appointed assistant chief of the tank and vehicle section of the Supply Branch of the Tank-Automotive Center of the Ordnance Department. Mr. Doran was in a cavalry unit in World War I, and joined Chevrolet following the war. He was with this division for 20 years, and was assistant general sales manager of Chevrolet before transferring to the Fleet Division in 1940.

The appointment of **A. W. LAVERS** as a member of the SAE War Activity Council was approved at a recent Council meeting. Mr. Lavers, chairman of the Tractor War Emergency Committee, is chief engineer of the Automotive Division, Minneapolis Moline Power Implement Co., Minneapolis.

GENE D. SICKERT has been transferred from assistant sales manager to chief engineer, Perfex Corp., Milwaukee.

The National Malleable & Steel Casting Co., announced the advancement of **WILSON H. MORIARTY** to the position of assistant to president. Mr. Moriarty, who has been instrumental in developing and perfecting several types of malleable iron and steel castings now widely used in war production, joined the company 23 years ago. Before advancing to his present position he was sales manager.

Assistant to President

The Mutual Broadcasting System recently announced the appointment of **MILLER McCLINTOCK** as president. Dr. McClintock, who is well known in advertising for his work as executive director of the Advertising Council, resigned from his position of director of the Bureau for Street Traffic Research, Yale University, New Haven, Conn.

Miller McClintock

WILLIAM A. HEINE, JR. has joined the Acromark Corp., Elizabeth, N. J., as chief engineer, having left his position of automotive engineer with the Tide Water Associated Oil Co., Bayonne, N. J.

WOLFGANG E. SCHWARZMANN has become consulting engineer for the American Bosch Corp., Springfield, Mass. He had been chief engineer of the Aviation Division of the company.

THOMAS A. SCANLAN is sales engineer of the Eberhard Mfg. Co., Division of Eastern Malleable Iron Co., Cleveland, Ohio. Formerly he held a similar position with the Corbin Cabinet Lock Co., New Britain, Conn.

VERN S. WHITE, who had been project engineer, Aircraft Engine Division, Continental Motors Corp., is now a design engineer of the Ford Motor Co., Dearborn, Mich.

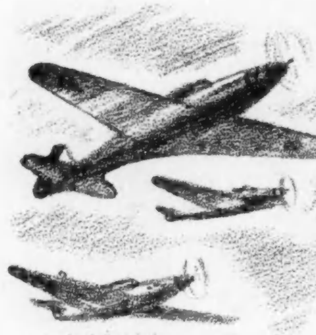
NORMAN S. HARDY, Belmet Products, Inc., Brooklyn, has been promoted from production engineer to assistant secretary.

Formerly tool designer at Wright Aeronautical Corp., Lockland, Ohio, **SYLVAN EUGENE BURKE** is now chief tool designer in the Propeller Division, Wickwire Spencer Steel Co., New York City.

F. R. BARKER, formerly munitions and supply officer, the Dominion of Canada, Department of Munitions and Supply, Ottawa, has terminated his service with the Canadian Government, and is now connected with Sicard, Ltd., Montreal, as development engineer.

HAROLD W. AGER, JR., is an automotive technician in the U. S. War Department, Desert Training Center, Camp Young, Calif. Mr. Ager had been with Richfield Oil Corp., Los Angeles, as automotive engineer.

turn to page 47



Organization of the ARMY AIR FORCES

by

MAJOR NATHANIEL F. SILSBEE

U. S. Army Air Corps

DURING 1942, air power continued to roll up an impressive array of facts indicating its decisive importance in the final victory. Hitherto acting on the side of the better-prepared Axis powers, as in the blitzkrieg campaigns in Europe and the rapid conquests in the Pacific, in the hands of the United Nations the tide is beginning to turn. Those who sowed the wind of air power are even now beginning to reap the whirlwind of greater air power. The Japs in the South Seas and Rommel's fleeing remnants have learned something of unopposed destruction from the skies, while the industrial and communications centers of the Reich and occupied territory have already undergone smashing attacks of undreamed of proportions.

In defense as well as in attack, air power has proved of priceless value. Over Dunkerque and during the air Battle of Britain, the Royal Air Force gained local air superiority and stopped the *Luftwaffe* cold. Last winter the Soviet Air Force, underrated by the Nazi high command, was a major factor in holding off the enemy. The air blitz on supply lines has seen remarkable examples in rolling back Rommel and stopping the ambitious Nipponese in the Solomons and New Guinea.

■ Air Power Ingredients

To gain the air superiority that we need if our side is to win the war, America must have a properly balanced air force. This includes a sufficient quantity of high quality *airplanes* – bombers, fighters, reconnaissance, transport. We must have hundreds of thousands of well trained *air men* – and that means not only the air crews, such as bombardiers, navigators, pilots, and gunners, but also the ground crews whose important job is to "keep 'em flying." We must have *air bases* at strategic points, including landing fields, storage and maintenance facilities, housing and technical installations, and all that goes to enable a modern air force to carry on. To maintain American air force offensive actions at the far-flung battle fronts an *air supply* system must be in operation.

[This paper, entitled "Air Power in Action," was presented at the Cleveland Section Meeting of the SAE, Cleveland, Ohio, November 9, 1942.]

On this four-square basis, America's striking power in the air is being built: airplanes, air men, air bases, air supply.

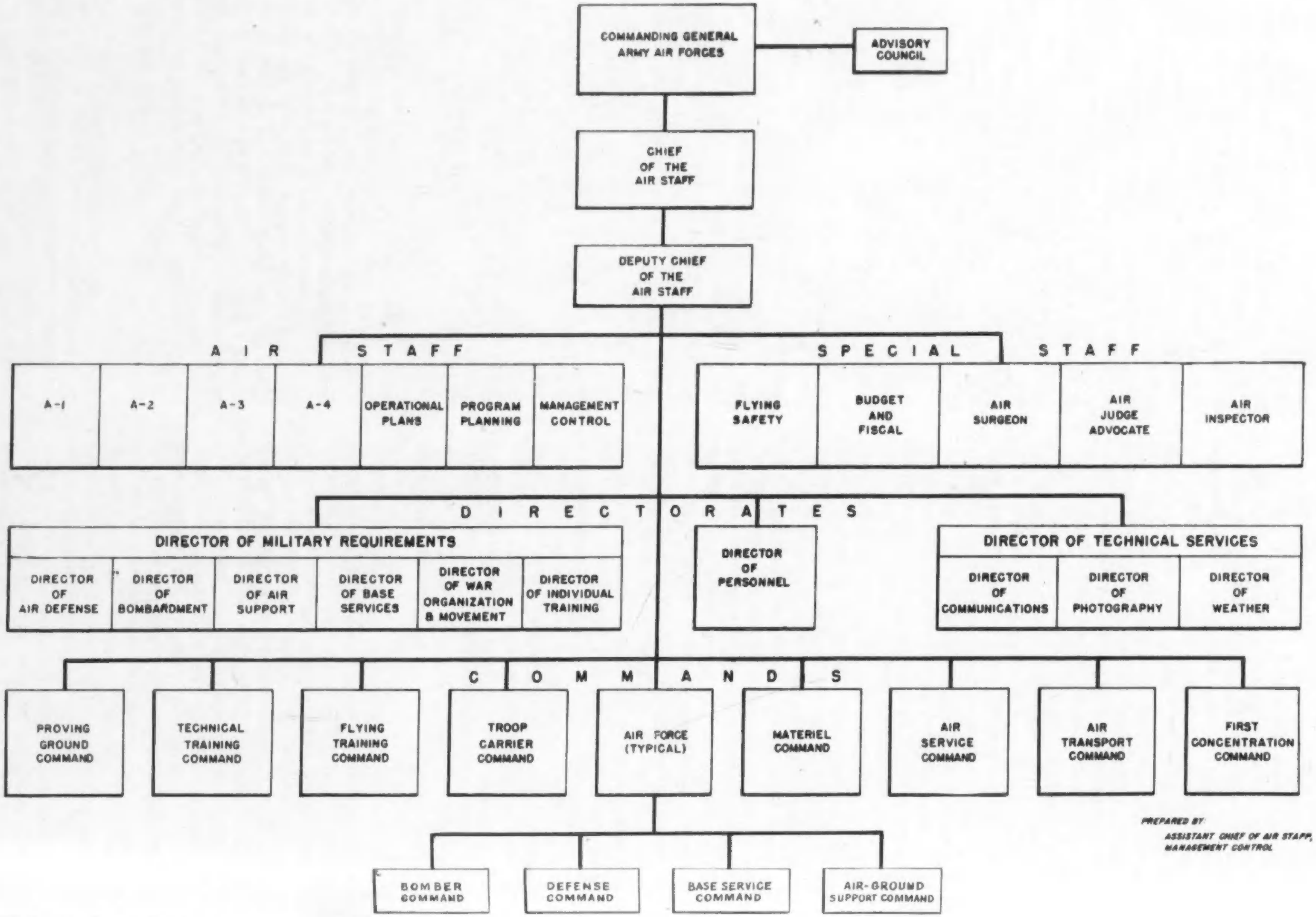
Is this stuff at last really rolling? Our phenomenally expanding aircraft and engine industry, now the biggest industry in the country, is beginning to take care of the airplanes, having already exceeded the rate of 50,000 planes per year, with the quality, as we shall see presently, top notch. Already on a dozen fronts the box score demonstrates that our planes are beginning to show their ability to outfly, outbomb, and outshoot the best the enemy has to offer. Some of our new fighters, bombers, and transports, many of which have already flown but are still restricted, are enough to make the angels gasp. Speeds, fire-power, bomb loads, range, ceiling, safety features – all are there. But to keep this edge in quality, the aeronautical-research facilities of the country must be kept in top gear. The enemy is working on this day and night. Our set-up includes the aircraft industry, Wright Field, Naval Aircraft Factory, and National Advisory Committee for Aeronautics, with its establishments at Langley Field, Va., Moffett Field, Calif., and the new engine-research laboratory near Cleveland.

Our training programs, under the command of such veteran air officers as Major-Gen. Barton K. Yount (Flying Training Command) and Major-Gen. Walter R. Weaver (Technical Training Command), have been expanding at an amazing rate, and well trained air crews and ground crews are coming out by the thousands every month. The daily paper will give you plenty of examples of how well they are doing their stuff.

Our engineers and construction crews have been busy for well over a year establishing the necessary air bases for action in the main theaters of combat. The results of one of these are seen in the recent air action in the Aleutians, others in the constantly stepped-up tempo of the daylight bombing raids over western Europe.

Major-Gen. Harold L. George's Air Transport Command, starting with a couple of officers and clerks in June, 1941, as the Air Corps Ferrying Command to fly lend-lease equipment from the factories, has now become a round-the-world air service for men, material, and mail which already surpasses the combined operations of all the air lines in the world. Four great airways have been estab-

ORGANIZATION OF THE ARMY AIR FORCES



lished, and thousands of airplanes, key personnel, and millions of pounds of vitally needed supplies for our six-continent air force and other fighting units have been flown to the various fighting fronts with an amazing record of safety. Air supply, a long established principle of American air doctrine, is rapidly becoming a vital factor in world strategy for winning the war.

■ How the Air Force Ticks

As business and professional men, it may be you would like to have a glimpse of the Army Air Force set-up. The overall policy is under the direction of General Arnold (commanding general, AAF), an Air Staff, and a Special Staff, as shown on the accompanying organization chart. Recognition of the decisive importance of air power in all phases of modern warfare is shown in the War Department's setting up of a compact air-ground Army General Staff, about one-half of whom are from the Air Staff.

The next group comprise the Operating Directorates, divided into Military Requirements, Technical Services, and various administrative and management agencies.

Operating directly under the Commanding General of the Army Air Forces, eight great commands compose the last stages of Air Force preparation for combat organizations. We have already noted the functions of the Flying Training Command, the Technical Training Command, and the Air Transport Command. The Matériel Command, under Major-Gen. Oliver P. Echols, a member of C. E. Wilson's small but powerful Executive Production Committee of WPB, procures aircraft and equipment, and conducts research and development at Wright Field. According to a recently announced decision, a larger proportion of our available raw materials will go into aircraft, in a greatly expanded program. Major-Gen. Henry J. S. Miller's Air Service Command operates air depots, repairs and maintains aircraft and equipment, and insures a constant flow of parts and supplies to all units, domestic and overseas. The Troop Transport Command is responsible for transporting air-borne troops and equipment, parachute troops and equipment, and for towing troop and cargo-carrying gliders.

To provide air forces, the final stage is Operational Training. As personnel and aircraft are received from the training schools and factories they are trained as units, with emphasis on the development of smoothly working combat teams. They are then dispatched to task forces and defense commands where they fight under the direct command of an air officer chosen by reason of his training and experience in connection with the particular mission then required. Sometimes this air officer is in command of the entire Army installation, ground and air forces, as in the case of Lt.-Gen. Andrews in the Middle East (Major-Gen. "Louie" Brereton is his air chief), Lt.-Gen. Emmons in Hawaii, or Major-Gen. Harmon in the Solomons. On the other hand sometimes the air officer is under the command of a Ground Force officer such as Major-Gen. Doolittle, air chief for Lt.-Gen. Eisenhower in North Africa, Lt.-Gen. Kenney for General MacArthur. Under the principle of unified command, sometimes the commanding general of a given area comes under the Navy (Hawaii under Admiral Nimitz, South Pacific under Admiral Halsey, and the Aleutians under Vice-Admiral Freeman), and sometimes it is the other way about (as in the Canal Zone, with Lt.-Gen. George H. Brett in top command).

These air combat forces include all units of military aviation such as bombardment, interception, observation, ground-air support, together with the necessary maintenance service.

The over-all picture of the Army Air Forces organization may thus be summed up under four key words: policy, operations, commands, forces.

Success in the race for air supremacy depends upon quality. In actual air combat, inferior planes are worse than none. In 1940, the outstanding event of the war in the air was the Battle of Britain. The hitherto invincible *Luftwaffe* was turned back largely because of the edge in speed and fire-power of the eight-gunned Spitfires and Hurricanes over the Messerschmitt 109's and Heinkel 112's, despite the overwhelming quantitative superiority of the Nazis. The wholly unsuspected quality of the Soviet fighters such as the speedy I-18 (sometimes called the MIG-3, combining the initials of the two designers) and the heavily armed and armored IL-2 or *Stormovik* bomber-fighter proved more than a match for the Me-109E fighter and Ju-88 fast bomber one year later

■ American Record

Today, about one year after our active entrance into the conflict, sufficient combat experience has been gained to form an estimate as to the quality of American planes under fire. The record is impressive, all the more so because of the initial losses sustained by surprise attack and local treachery, and because much of the equipment which was available during the first few months was largely obsolescent. The speed, heavy fire-power, protective armor plate, diving ability, and general ruggedness were fighting qualities which gave Army Air Force bombers as well as fighters, an increasing edge in aerial combat performance. From February 1 to August 1, 1942, the period of greatest disadvantage, during which we were largely carrying on defensive and delaying actions against overwhelming odds, the ratio was two enemy airplanes shot down to one of ours. Beginning in August, American air power began to play a really important part on several fronts – stopping the Japs in the South Pacific and the Aleutians, helping blast Rommel out of Africa, commencing the eye-opening daylight raids over Europe with our Fortresses and Liberators, and playing a vital part in our North-African campaign. For the past few months, the ratio has increased to 8 to 1. The Navy and Marine figures are no less remarkable. The main reason is the fact that by that time balanced air forces in these areas were being built up. Newer models became available such as the Boeing B-17E Fortress with stinger tail guns, and the Curtiss P-40F Warhawk with higher ceiling than earlier models. Newer types, such as the speedy Lockheed P-38 Lightning interceptor-fighter, with its fast climb, high ceiling, and long range were thrown into action. Balance was rounded out by the appearance in these areas of models already highly successful elsewhere, such as the fast, powerful bomber-fighter Douglas A-20 Havoc, hard-hitting medium bombers, including Martin Martians (B-26), and North American Mitchells (B-25), and long-range 4-engine Consolidated Liberators (B-24). A great proportion of these new planes were flown to the theaters of action, and Air Transport Command's increasing flow of cargo planes kept the supply of spare engines and parts coming along. The establishment of the Overseas Division of the Air Service Command completed the picture with its ground technicians and facilities to keep an ever larger proportion

of our planes actually in the air. Other factors include combat experience of our pilots and crews, and increased skill in handling our deadly 0.50 caliber guns, both hand-turned and power-turret types.

It should be more generally realized that there is often a considerable time lag before a new military airplane can be successfully thrown into battle. For example the powerfully armed Bell P-39 Airacobra was designed in 1937-1938, prototype test-flown in the spring of 1940, in good production about a year later, and in action on several fronts from early 1942. It is highly regarded by the Russians as an antitank weapon as well as in combat against Nazi bombers and fighters.

The fast-climbing Lockheed P-38 Lightning, twin-engine interceptor-fighter, was tested in a flight across the country in February, 1939, in about seven hours and a half, including stops for fuel, at about two-thirds throttle, hitting around 400 mph while crossing the Alleghenies. A large number of changes in the prototype delayed quantity production on the P-38E (the model tentatively selected for combat operation) until the summer of 1941. Operational tests revealed the necessity of eliminating tail flutter at high speeds, other changes in the interests of increased safety were made, and an improved turbosupercharger installed, all of which added up to the P-38G, the model reported in successful action on various fronts during the past few months. It has the fastest climb and longest range of any single-seater fighter in the world.

The Airacobra and the Lightning had design features which have rightly been termed "unorthodox" (one way in which major improvements can be achieved). This is ample justification of a four to five-year board-to-battle record. Another new fighter is the Republic P-47 Thunderbolt, which is a more conventional design, though with plenty of distinctive features of its own. Its family tree goes back to the P-35, of which the P-43 was a stepped-up version with a 1200-hp engine and turbosupercharger for high-altitude operation. The P-44 was an improved P-43, with six heavy machine guns, a 1350-hp engine and the latest gadgets available in 1940. The fighter-plane experts at Wright Field passed on to Republic's engineers certain things they wanted in a powerful slugger that would dominate the upper air, and the expensive XP-44 mock-up, good as it was, had to be scrapped. In September, 1940, the XP-47 was designed, and by May, 1941, the prototype was test-flown. Improvements were made, and while production on the P-43 was tapering off, the factory began tooling up for what became the P-47, with 2000-hp Double Wasp engine. Speed has been announced as better than 400 mph, ceiling up to 40,000 ft, with six or eight of the same 0.50-caliber high-velocity machine guns which have proved so devastating in the Fortress and Liberator heavy bombers. Further testing brought other important improvements, and by spring, 1942, the advanced model P-47D was in limited production. Six months later good production was achieved at the parent factory and begun at a midwestern branch; it has also been announced that another major aircraft producer is rapidly tooling up one factory to turn out this formidable fighter. The Thunderbolt should soon be in action against the challenging Messerschmitt 109G, and new Focke-Wulf 290, both high-altitude fighters.

So much for time lag in production, and despite engineering and production short cuts which have become possible in the light of the huge orders which have been placed with the aircraft companies (and some of these have been noteworthy), it is still largely true that there is no substitute for time when it comes to the development of successful military aircraft. In addition to the attainment of a good production rate, however, there are two other factors tending to delay a particular model of a fighter or bomber coming into combat action. The first is the need of building up a reserve after the squadrons have received their initial equipment. A statement recently appeared in *The Aeroplane* (London) to the effect that no new model fighter plane would see combat action until about one thousand were at hand; this may vary somewhat in particular cases. The other factor is the necessity for months of tactical training to ensure that perfect teamwork which is largely responsible for winning modern air battles.

■ Elastic Production

Military airplanes are not only tailor-made as to types, but during war a feverish struggle is constantly going on to obtain superiority over the enemy. Each change for the better which one side makes, each improvement in speed, ceiling, or armament, must be followed as fast as possible by more effective changes in the other fellow's planes. This prevents airplanes from being built on strictly mass-production methods, freezing designs. This is why the aircraft industry has had to maintain the highest possible degree of flexibility in its production, even though it means a somewhat slower production rate. As a matter of fact the present large-scale orders for planes in 1000- and even 5000-lots, with pooled production and a high degree of subcontracting, has more nearly made this possible than at any time hitherto. Nazi Germany made the mistake of freezing designs on the Me-109 single-seater fighter, the Ju-87 Stuka, and other planes to ensure overwhelming quantitative superiority. The Battle of Britain taught them the lesson and they are now coming through with the required changes more quickly. One of the factors which has enabled American flyers to overcome terrific odds so far in practically every combat area, is the fact that American factories are to a large extent keeping pace with battle-front developments and putting into our warplanes the required changes with a minimum of delay, and yet not interrupting the flow of fighters and bombers to the front. A recent instance, is the transition from the Boeing B-17E to the F, including some 400 minor changes. It so happened that the day the first B-17F came off the line the last of the B-17E's was being delivered, and the total for that month, instead of dropping off, was slightly increased.

■ Life or Death Changes

Here is the kind of change that must be provided for. For example, word comes back from Egypt that the landing gear on a certain bomber is causing too many crack-ups, or maybe two of the 0.30-caliber guns should be replaced by 0.50's, and certain changes are suggested. Many of our large aircraft and engine companies such as Douglas, Lockheed, and Wright Aeronautical have expert trouble-shooters in the important theaters of action, and in coordination with Air Force officers on the spot the word gets back quickly. Until the change can be made in the production line proper, which may take several weeks, each airplane is flown to a modification center where the change is made before the plane is flown to the front.

There are several dozen of these modification centers located in various parts of the country. Some of these are operated by our principal aircraft producers, some by skilled crews of our nation's domestic airlines, and a few by air force personnel at the various air depots.

The philosophy of the modification center is simple. As one officer puts it, "Suppose you make kitchen stoves. Your factory is all tooled up for one model on a quantity basis and you're turning out thousands of them. Then your head salesman tells you that you've got to add another gadget or your competitors will run you out of business. Which is easier – retooling your whole plant or adding another shop where the gadget can be installed on the stoves before they meet their competition?" This permits up-to-the-minute developments to be incorporated in combat aircraft without interrupting the flow of production. In this connection Capt. Eddie Rickenbacker had an excellent word of advice on his return from an inspection of our new air bases in England. He urged that every major aircraft company send its chief engineer and production manager to the more important fronts at least once and preferably twice each year; with these fronts only a few hours away by transport plane this should be feasible, and the results would pay richly. In air warfare, time is priceless.

■ Groomed for Battle

Another function of the modification center is that of adapting our planes for special jobs, such as the Doolittle raid on Tokyo, or for certain combat areas where special conditions are encountered. For example, North American B-25 Mitchells are painted a dusty pink for service on desert fighting fronts; and this hard-hitting medium bomber, as well as other planes for this front, are fitted with extra fine filters to keep out as much of the sand as possible. Other types of ships have to be adapted for operating under Arctic conditions. One of the outstanding examples occurred before the modification centers were developed, but it illustrates the urgent necessity of "must" alterations being worked into our combat aircraft. It is well known that the Japs found no tail guns in the Fortress B-17's they met over the Philippines, mostly B-17C's and D's. Even though the Jap guns downed very few of these big boys in flight, owing to their speed and amazingly rugged construction, our combat crews out there clamored for tail guns – and they got them in record time. The Nip pilots didn't know what struck them, and it is reported that nearly a hundred of them were downed before anyone was able to get back and tell the others what was happening. From the battle of Midway on, they have kept a healthy distance from our new Fortresses (B-17E's) and history is repeating itself on the western front with Goering's picked aces in Focke-Wulf 190's.

■ American Warplanes Vindicated

In addition to a baptism of fire on the various fighting fronts, American planes, particularly fighters, were subjected to a barrage of heavy criticism during the summer and early fall of 1942. Much of it was based on inadequate information, some of it came from sources now suspect. The revised opinion of the Truman committee (late September, 1942, after secret sessions with Major-Gen. Echols, Air Forces Matériel chief, recently returned from England, and other expert observers and pilots from the fighting fronts) was that the "record showed definite improvement." On October 2, 1942, Dow Harter's Special Committee on Aviation rendered a comprehensive report, based on similar investigation and testimony, which was on the whole very encouraging. A few days later Capt. Eddie Rickenbacker returned from an inspection trip to England and gave a complete report to Secretary Stimson in which he said, "In England I had full opportunity to visit the various bombardment and fighter units of the American Air Forces, as well as to confer with the members of the high command of both British and American Air Forces. My opinion is that American conceptions of Army aircraft and their tactical employment are proving sound in combat and that the British look upon the practical application of our air-war theories with increasing approval." This report was followed on October 19 by an informative and well-balanced report by OWI entitled "Design and Operation of United States Combat Aircraft." This was given wide publicity in the press and was reassuring as to the general superiority of American airplanes, although it warned "The best the public can expect, and the best it will get, is that on the average the equipment of the Allied Air Forces shall be superior to the equipment of the enemy."

■ The Race Goes On

As at the turn of the year it is generally agreed by international aviation authorities that out of about 15 important type classifications, including land-based and carrier-based fighters and bombers, seaplane patrol boats and cargo planes, and land-based transports, American planes rank tops in all but two or possibly three classifications. New models may enable American Air Forces to retain or even better this superiority, both in quantity and quality. However, reports of a new German high-altitude bomber and at least one fighter plane with pressurized cabin provide sharp reminders that no country has a corner on aeronautical research. No airplane is better than its powerplant, and in the aircraft-engine field reports have been received concerning the BMW 802 radial aircooled engine, 18 cyl and 3280 cu in., turning up some 2000 hp, which brings it into the class of our P & W Double Wasp (R-2800) and Wright Duplex Cyclone (R-3350). The BMW 802 is reported as in production and as powering some of the newest bombers and fighters, such as the Dornier 217E-2 and Focke-Wulf 290. There is also mention of its being equipped with a three-speed, two-stage supercharger, and this clicks with other reports of actions of the newest Spitfires powered by improved Merlin engines and new German fighters scrapping it out beyond the 40,000-foot level. Evidently our Thunderbolt high-altitude slugger will find some work to do "up there."

We have to keep on our toes; and boldness, imagination, and everlasting research are required to meet possible threats by air. When air supremacy is achieved over land and sea, the road to final victory is assured, and with it the hope of a more stabilized and cooperative world order. This has its challenge to America both in the need of helping to maintain some sort of an international air policing set-up, and also in globe-girdling air-passenger and cargo transportation as an effective aid in reconstructing a war-weary world. The airplane will continue to revolutionize our thinking and planning, and in the new air age Wings of Power will have to function for a long time, but this will not necessarily interfere with Wings of Peace.

About SAE Members

continued from page 41

FRED **W. CEDERLEAF** is works manager of the Detroit Transmission Division, General Motors Corp. He was formerly plant manager of the Republic Aircraft Products Division, Aviation Corp., Detroit. Mr. Cederleaf, an SAE member since 1919, is a past vice-president representing the Production Activity.

E. **VERLIN BROWN** has been made general inspection foreman, Curtiss-Wright Corp., Propeller Division, Indianapolis. He had been liaison inspector.

One of the three awards of The Arthur Williams Memorial Medal, by the American Museum of Safety, was to Rear-Admiral **EMORY S. LAND** "for outstanding contribution to the conservation of human life through safe construction and operation of ships."

Among those who received awards in the $200,000 Industrial Progress Award Program of the James F. Lincoln Arc Welding Foundation were the following SAE members: **E. W. WEAVER,** consulting design engineer, Towmotor Co., Cleveland; **W. W. SLAGHT,** chief engineer, Cleveland Steel Products Corp.; **R. W. SNOOK,** designing engineer, Superior Coach Corp., Lima, Ohio; **RAY F. KUNS,** president, Trotwood Trailers, Inc., Trotwood, Ohio; **JOHN K. NORTHROP,** president, Northrop Aircraft, Inc., Hawthorne, Calif.; **PETER F. ROSSMANN,** chief of miscellaneous developments research, Research Laboratory, Curtiss-Wright Corp., Buffalo, N. Y.; **WILLIAM A. F. MILLINGER,** professional engineer, Engineering Project Services, Los Angeles, Calif.; **ROBERT C. ENGELMAN,** design engineer, Clark Bros. Co., Inc., Olean, N. Y.; **HOWARD W. SIMPSON,** chief engineer, Detroit Harvester Co.; **WALTER F. WHITEMAN,** chief engineer, William and Harvey Rowland, Inc., Philadelphia.

U. A. PATCHETT has been transferred by the Chrysler Corp. from the engineering department at Highland Park, Mich., to the new aircraft engine company, the Dodge Chicago plant, where he is engineer in charge of production tests. Mr. Patchett has been treasurer, vice-chairman and chairman of the Northern California Section.

U. A. Patchett

JACK OWEN, formerly purchasing agent for the Western-Austin Co., Aurora, Ill., has left that company and is now sales executive in the industrial rubber products division of the Thermoid Co., Trenton, N. J.

PAUL LOUIS SMITH, an engineer in the Douglas Aircraft Co., Inc., Santa Monica, Calif., is now assistant methods analysis engineer for the same company.

HENRY A. MOREAU is now connected with the Lockheed Aircraft Corp., in the modification center at Dallas. He leaves Alaskan Star Airlines, Anchorage, Alaska, where he was operations manager.

Formerly a technician in the development department of the Baldwin Rubber Co., Pontiac, Mich., **FRANCIS P. O'CONNELL** is an inspector of ordnance materiel at the Detroit Ordnance District.

ANKER K. ANTONSEN is no longer chief engineer of the Menasco Mfg. Co., Burbank, Cal., having left this company to join the AiResearch Mfg. Co., Los Angeles.

WILLIAM KNIGHT is supervisor of field service, the Curtiss Propeller Division of Curtiss-Wright Corp., at Caldwell, N. J.

HARRY J. CARMICHAEL, coordinator of production of Canada's Department of Munitions and Supply, has been appointed co-chairman of the Joint War Production Committee of the United States and Canada.

Harry J. Carmichael

JOHN L. BUNCE has been elected vice-president of the United Aircraft Service Corp., a subsidiary of United Aircraft Corp. Mr. Bunce joined the Pratt & Whitney Aircraft Division of United in 1927 as an assembly mechanic. Since then he has been successively assistant service manager, service manager, and secretary.

L. J. DAVIS has joined the staff of Federal Aircraft, Ltd., Toronto, the office in charge of subcontractors in Ontario. His duties will be coordinating and progressing the output of the various factories relative to the demand of the parent company. Formerly Mr. Davis was district manager of the Sealed Power Corp. of Canada, Ltd., Toronto.

IVAN H. NASH is no longer with the University of California, Berkeley, where he was an instructor in engineering defense training courses, having joined the power engineering section of Joshua Hendy Iron Works, Sunnyvale, Calif.

LIPMAN S. GERBER, electrical engineer in the U. S. Army Ordnance Department, has been transferred from the Tank and Motor Transport Branch, Industrial Service, to the Tank-Automotive Center, Engineering Offices, Detroit.

Suggestions for lengthening the life of the nation's vital and irreplaceable motor trucks and motor truck tires were offered recently by **WALTER F. ROCKWELL,** president of the Timken-Detroit Axle Co., Detroit, to City, State, and County highway or public works departments. Among his suggestions: "Make prompt repairs on chuck holes, broken pavements, bad bumps and sharp pavement edges. Any of these defects in highways and streets can cause damage to both tires and vehicles." Mr. Rockwell is a member of the Finance Committee of the SAE.

Walter F. Rockwell

DALE EMMET WILKINS is assistant project engineer on turbosuperchargers, Wright Aeronautical Corp., Paterson, N. J. He was promoted from senior test engineer.

Formerly superintendent in the assembly department of the Parker Appliance Co., Cleveland, **JAMES W. CARL** is now mechanical engineer at the Cleveland Pneumatic Tool Co.

ALLEN WESCOTT has joined the Eastern Aircraft Division of General Motors at Linden, N. J., as parts and service manager.

JAY A. YOUNG, who had been chief chemist at the Asbestos Mfg. Co., Huntington, Ind., is now associate ordnance engineer, Army Ordnance Department, Washington.

WOODROW L. WROBLEWSKI is a stress engineer, Briggs Mfg. Co., Detroit. He held a similar position with the Eastern Aircraft Trenton Division of General Motors, Trenton, N. J.

JOSEPH A. ANGLADA has completed his assignment with the Ordnance Department, Tank and Motor Transport Division, Washington, and is now associated with the Conversion Engineering Section of the Philadelphia Ordnance District.

ARTHUR R. PARILLA, formerly chief engineer of the Chicago Pneumatic Tool Co., Garfield, N. J., is now working on special assignments for the Eastern Aircraft Division, General Motors Corp., Linden, N. J.

Formerly a designer with the Yellow Truck & Coach Mfg. Co., Pontiac, Mich., **FRANCIS GALDO** now holds a similar position with Associated Designers, Birmingham, Mich.

GEORGE W. YANSS is field engineer for the Flex-O-Tube Co., Detroit. He was formerly district manager of the Bridgeport Brass Co., Detroit.

T. P. WRIGHT, aeronautical expert and vice-president of the Curtiss-Wright Corp., has been elected an honorary fellow of the Royal Aeronautical Society, an honor that has been accorded to only 15 of the society's total membership of 3000. **DR. JEROME HUNSAKER,** professor of Aeronautics at the Massachusetts Institute of Technology, and **ORVILLE WRIGHT,** pioneer aeronautical engineer, are two other SAE members who have been awarded that honor.

Formerly associate professor, Industrial Education, in charge of aeronautics, Santa Barbara State College, California, **E. A. ROSS** is now with the Utah State Agricultural College, Logan, Utah, as professor of aeronautics and head of the department.

A. W. FREHSE, formerly engineer in the Chevrolet Motor Division of the General Motors Corp., Detroit, is now field service manager at the Aviation Engine Plant, Chevrolet Motor Division, Tonawanda, N. Y.

E. J. Welker

E. J. WELKER is employed as civilian chief of the Machine Tool Unit for the Small Arms Branch of the War Department, Washington. Mr. Welker had been sales engineer at the Welker Machinery Co., Inc., Detroit.

GEORGE B. LACY is special representative of the Bureau of Aeronautics, Navy Department, and is stationed at the Midwestern Procurement District of the Army Air Forces, Wichita, Kans. Formerly Mr. Lacy was sales representative of the White Motor Co., Washington.

EUGENE J. MANGANIELLO has been promoted from associate mechanical engineer to mechanical engineer, National Advisory Committee for Aeronautics, Langley Field, Hampton, Va.

Formerly in the maintenance department of the Wright Aeronautical Corp., Lockland, Ohio, **CLYDE G. HAYNES** is principal automotive adviser in the U. S. Army, 92nd Infantry Division, Camp Breckenridge, Ky.

RENE BERG, consulting engineer, has formed the American Premaberg Co., New York City, handling subcontracts for defense work for the U. S. Navy, and the aviation and oil industries.

MARY LEE MARQUIS (Mary Lee Wilkerson) is now connected with the General Electric Co., in Schenectady. She is an engineer in the aircraft and marine department.

ELLIS W. TEMPLIN is the winner of a $300 war bond in the Los Angeles Water & Power Co.'s victory campaign. Mr. Templin is an automotive engineer for the company.

EWALD J. WOLFF, who had been an engineer with the Research Laboratories Division of the General Motors Corp., Detroit, has been promoted to assistant head of Mechanical Engineering Department No. 6, same company.

KENNETH G. BACHELLER, who had been production liaison engineer, Jacobs Aircraft Engine Co., Pottstown, Pa., is now a resident engineer at Pratt & Whitney Aircraft.

Formerly fleet sales supervisor, Milwaukee Ave. Motor Sales, **HENRY C. MEYER** is now superintendent of automotive transportation, the Equipment Finance Corp., Chicago.

FRANK M. KINCAID, JR., Wright Aeronautical Corp., Paterson, N. J., has been promoted from assistant project engineer to project engineer.

WILLIAM FLOYD BEASLEY is chief engineer of the Tank and Motor Transport Development Branch, Army Ordnance Department, Washington. Mr. Beasley was formerly principal automotive engineer, U. S. Army, Ordnance Department, Washington.

JOHN H. CARSTENS has joined the New York City branch of the Cleveland Twist Drill Co., as tool service engineer.

RUDY L. BRADSHAW is with the Public Roads Administration, Seattle, where he is equipment superintendent in connection with the construction of the Alaska Alcan Highway. Mr. Bradshaw was formerly in the CCC Motor Repair Division, Salem, Ore.

H. E. WHITMORE, who had been superintendent of the equipment depot, Federal Works Agency, Public Roads Administration, Denver, Colo., is now shop superintendent with the U. S. Army, Corps of Engineers, headquartered at Granite City, Ill.

CYRUS M. HAJEWSKI is associate automotive engineer in the U. S. Army, War Department, Ordnance office, Tank-Automotive Center, Detroit.

Formerly design engineer, Menasco Mfg. Co., Burbank, Calif., **CHARLES E. MacDONALD** is acting project engineer with Kinner Motors, Inc., Glendale.

WILFRED E. BETTONEY, who had been assistant mechanical engineer, U. S. Army Air Corps, Materiel Division, Wright Field, Dayton, Ohio, is now test engineer at the Dodge Chicago Plant of the Chrysler Corp.

WALTER O. WILL is president of Tools, Inc., Chicago. Mr. Will was formerly connected with the Service Tool Die & Mfg. Co., Chicago, as chief engineer.

DONALD E. CRESSEY, formerly aeronautical engineer, Douglas Aircraft Co., Inc., Santa Monica, Calif., has been transferred to the El Segundo plant of the company as aeronautical service engineer.

Formerly president of European-American Trade Development Corp., New York City, **GUIDO SORIA** has become general manager of John B. Salterini Co., also of New York City.

RAY H. EGGER is an automotive engineer in the Tank-Automotive Center, Technical Section, Detroit. Mr. Egger had been assistant automotive engineer, U. S. Army, Ordnance Department, Maintenance Division, Tank Unit, Washington.

H. T. DANIELS is with the Navy Department, Bureau of Ships, Washington, as senior mechanical inspector of ship construction.

Formerly an electrical engineer, **RANDOLPH MATSON** has been named project engineer, the Douglas Aircraft Co., Inc., Oklahoma City Plant.

Among the instructors in the technique of the "Shotweld" system of welding stainless steel, inaugurated at the Edward G. Budd Mfg. Co., is **COL. E. J. W. RAGSDALE.** Chief engineer of the Hi-Tensile Division, Col. Ragsdale is one of the inventors of the system.

JAMES B. MISNER has accepted a position as service engineer for Consolidated Aircraft Corp., San Diego, Calif. Mr. Misner, at present headquartered in San Diego, has been made western area supervisor, covering all Army and Navy aircraft manufactured by this firm, and operating in the area west of the Mississippi River. He was formerly property and supply officer, U. S. Army Air Corps, Santa Monica, Calif.

Formerly draftsman for the Menasco Mfg. Co., Burbank, Calif., **JOEL M. GOOCH** is now with the Guiberson Diesel Engine Co., Dallas, Tex., as engineering draftsman in the Research Department.

Col. Azel Ames

Col. Azel Ames, 69, retired from the Coast Artillery Reserve and a veteran of the Spanish-American and World Wars, died Nov. 23 at his home in Yonkers, N. Y. He was an executive of the Kerite Insulated Wire and Cable Co. of New York City, with which he had been associated since 1909. Col. Ames, an SAE member since 1912, was for many years on the Electrical Equipment Division of the Standards Committee of the Society.

George H. Hunt

George H. Hunt died Nov. 25 of a heart ailment. Mr. Hunt attended the University of Chicago and Yale University. He was an automotive manufacturing agent, and was instrumental in the development of safety glass.

Robert B. Gundel

Robert B. Gundel, a junior member of the Society, died in an accident at the U. S. Navy Pre-Flight School, Chapel Hill, N. C., on Oct. 28, at the age of 23. He was a former junior test engineer at the Wright Aeronautical Corp. in Paterson.

G. B. Upton

G. B. Upton, professor of automotive engineering at Cornell University, died suddenly Oct. 29, at the age of 60. He was analyst and consulting engineer for the Curtiss Airplane Co., the U. S. Government, and the National Advisory Committee for Aeronautics. Mr. Upton contributed numerous articles to technical journals, and was the author of "Materials of Construction."

In Military Services

CAPT. **JOSEPH A. DOYLE** has been transferred from the Office of The Quartermaster General, Washington, to the Office of The Chief of Ordnance, Tank-Automotive Center, Detroit. Capt. Doyle is technical adviser on maintenance tools and equipment for tanks and automotive vehicles.

Capt. Joseph A. Doyle

DOUGLAS J. KUHLMAN has been commissioned a first lieutenant in the U. S. Army, and has been assigned to the Holabird Ordnance Base, Baltimore, Md. He was formerly manager of the Chicago branch of the Heil Co., Milwaukee.

A. LINCOLN PITTINGER is on leave of absence from the Norma-Hoffmann Bearings Corp., Stamford, Conn., where he had been Detroit field engineer. He is now an ensign in the U. S. Navy, Ordnance Department.

Formerly a first lieutenant, U. S. Army Ordnance Department, Hickam Field, T. H., **K. L. STEHLE** is now a captain, Hawaiian Air Depot, Engineering Section, Hickam Field.

On leave of absence from the College of the City of New York, School of Technology, where he was an instructor of mechanical engineering, **2ND LT. LAWRENCE WHEM** is in the Air Service Command, U. S. Army, stationed at Duncan Field, San Antonio, Tex.

CLYDE M. HALLAM, U. S. Army, Field Artillery School, Department of Motor Transport, Fort Sill, Okla., has been promoted from major to colonel.

THOMAS W. LANCER is stationed in field artillery at Fort Bragg, N. C., where he is instructing in basic electricity and automotive electrical circuits in a motor mechanics battery. Before entering the service, he was employed by the Gulf Oil Corp. as a dynamometer operator and was a student at the Polytechnic Institute of Brooklyn.

OTTO A. OLSON is head automotive adviser, 91st Infantry Division, U. S. Army, Camp White, Medford, Ore. He was formerly garage superintendent, Portland Gas & Coke Co., Portland, Ore.

CAPT. JOHN D. ZERBO has been transferred from the Rock Island Arsenal, Illinois, to the Tooele Ordnance Depot, Tooele, Utah. In civilian life, Capt. Zerbo was with Strietmann Biscuit Co., Division of United Biscuit Co. of America, Cincinnati, where he was traffic and service manager.

DONALD B. ROBERTS, captain in the U. S. Army Air Forces, is stationed in the Motor Transport School, Normoyle Quartermaster Motor Base, San Antonio, Texas. Capt. Roberts was formerly at the Air Depot Training Station in Albuquerque, N. M.

Transfer of **S. G. NORDLINGER** from Wright Field, Dayton, Ohio, to the Dodge Chicago Plant, recently took place. He was promoted from captain to major.

1ST. LT. SAMUEL KALMIN has been transferred from the Quartermaster Corps, Holabird Motor Base, Camp Holabird, Md., to the Normoyle Ordnance Motor Base, San Antonio, Texas.

S. CORWIN BRITTON has been promoted from lieutenant to captain, U. S. Army Ordnance Department, Plum Brook Ordnance Works, Sandusky, Ohio.

ALLAN A. BARRIE, formerly major, has been promoted to lieutenant colonel, and is stationed at Hamilton Field, Calif., where he is Pacific Wing Operations Officer, Air Transport Command.

JOHN H. SMITH, formerly fleet and traffic manager, Esslinger's, Inc., Philadelphia, is a technical sergeant, Company O, 303rd Regiment, Ordnance, Camp Sutton, Monroe, N. C.

WILLIAM B. DRAYTON is a motor machinist mate, U. S. Navy, Dry Dock, South Boston, Mass. Mr. Drayton had been service manager at W. J. Walker Co., Wakefield, Mass.

Formerly lubrication engineer, American Oil Co., Baltimore, Md., **H. I. GLASHOFF** is now a warrant machinist, U. S. Coast Guard Training Station, Groton, Conn.

CAPT. SIDNEY G. HARRIS, Office of The Quartermaster General, has been appointed a member of the War Department Committee on Liquid Fuels and Lubricants.

LT. (jg) EARL W. SHAW, JR., USNR, is at present stationed at Naval Training Station, Harvard University, Cambridge, Mass. Lt. Shaw had been with the U. S. Naval Engineering Experiment Station, as junior mechanical engineer in the Internal Combustion Laboratory, Annapolis, Md.

J. D. WAUGH is in the 1st Service Area Air Depot, 8th Air Force Service Command, A.P.O. No. 813, New York, N. Y. In civilian life he was an instructor, aircraft engines and propellers, Lockheed Overseas Corp., Division of Lockheed Aircraft Corp., Burbank, Calif.

WALTER C. PEW has been promoted from major to lieutenant colonel, U. S. Army, Ordnance Department.

Formerly general sales manager of the American Brakeblok Division, American Brake Shoe & Foundry Co., Detroit, **P. B. HOFFMAN** is now a lieutenant (jg) in the U. S. Navy.

LT.-COM. CARL J. VOGT, USNR, is officer in charge, the Naval Training School, Diesel Engineering, University of California.

CAPT. E. Q. BECKWITH is in the U. S. Army, Office of The Chief of Ordnance, Toledo Tank Depot, Toledo, Ohio.

Formerly chief tool designer, American Locomotive Co., Schenectady, N. Y., **WILBUR C. RICE** is now on active duty as a second lieutenant. Lt. Rice is supervisor of tank production.

CAPT. GARDNER SMITH, U. S. Army Air Forces, has been transferred from 46th Air Base Squadron, Hamilton Field, Calif., to 44th Air Base Squadron, Army Air Base, Portland, Ore.

Formerly internal combustion engineman, U. S. Naval Engineering Experiment Station, Annapolis, Md., **FERDINAND J. KOCI** is now a U. S. Coast Guard, U. S. Coast Guard Academy, New London, Conn., as motor machinist mate, first class.

WILLIAM N. HITE, U. S. Army Air Forces, Advanced Flying School, Luke Field, Ariz., is now a captain, in section command.

Major Robert H. Reid

Formerly at Fort Monroe, Va., **MAJOR ROBERT H. REID** has been transferred to the Edgewood Arsenal, Maryland, where he is a post ordnance officer.

MAJOR G. B. HARRIS formerly in the U. S. Army Quartermaster Corps, Maintenance Division, Motor Transport Service, Washington, is now in the Corps of Engineers, Northwest Service Command. Major Harris can be reached in care of the Postmaster, Seattle, Wash.

Formerly first lieutenant in the U. S. Army Ordnance Department, Aberdeen Proving Ground, Md., **DE OWEN NICHOLS, JR.** is now a captain, and is stationed at the Tank-Automotive Center, Detroit.

JOHN FREDERICK SWIFT is a second lieutenant in the U. S. Army Ordnance Department, Tank-Automotive Center, Detroit. Prior to duty in the Army, Lt. Swift was research and design engineer of hydraulic transmissions, Hydraulic Brake Co., Detroit.

CHESTER O. FRENCH, JR., formerly a lieutenant, has been promoted to captain, and is stationed at Wright Field, Dayton, Ohio. Capt. French is a project engineer in the U. S. Army Air Forces, Equipment Laboratory, Experimental Engineering Section.

CAPT. ROBERT B. PATTERSON has been promoted from lieutenant, and is stationed at the Detroit Ordnance District. He is assistant Army inspector of Ordnance.

Formerly in the experimental test department, Pratt & Whitney Aircraft, Division of United Aircraft Corp., East Hartford, Conn., **DONALD WALLACE MITCHELL** is now a fireman, first class, U. S. Coast Guard, New Haven, Conn.

RICHARD O. McMANUS is in the U. S. Army Air Forces, Aviation Cadet Detachment, Chanute Field, Ill.

CAPT. HARRY PRICE is post ordnance officer, commander of the Ordnance Detachment, U. S. Army Air Forces, Advanced Flying School, Moody Field, Georgia. He was formerly connected with the Office of The Chief of Ordnance in Washington. In civilian life Capt. Price was a New York patent lawyer.

WILLIAM B. BASSETT has been promoted to the rank of first lieutenant, U. S. Army, Service Branch, Technical Division, Office of The Chief of Ordnance, Washington. Lt. Bassett had been stationed at the U. S. Army Ordnance Department, Aberdeen Proving Ground, Md.

CAPT. ROBERT E. GOTTRON is a maintenance officer, Motor Transport District, U. S. Army Ordnance Department, Camp Haan, Riverside, Calif. In civilian life Capt. Gottron was a sales engineer for the Hercules Motors Corp. of Canton, Ohio.

MAJOR J. MENDES da SILVA is with the Brazilian Aeronautical Commission, Washington. He was promoted from captain.

LT.-COL. SETH B. ROBINSON, JR., formerly a major in the U. S. Army Motor Transport Division, Office of The Quartermaster General, Washington, is now with the Tank-Automotive Center, Ordnance Department, Detroit, as deputy director of manufacturing.

JOHN VANCE HEWITT, JR., has been commissioned a lieutenant, U. S. Navy, U.S.S. Albemarle.

KENNETH E. MONTAGUE is an ensign in the U. S. Navy. Ensign Montague, who had been aeronautical engineer at the Consolidated Aircraft Corp., San Diego, Calif., before entering the service, is now aeronautical specialist.

LT. MURRAY AITKEN is accessories officer at the Naval Air Station, Assembly and Repair Department, Jacksonville, Fla. Lt. Aitken had been assistant production engineer.

CAPT. PHILIP LeROY LOOMIS, U. S. Army, Fort Bragg, N. C., was recently made head of the Motors Division, F.A.R.T.C. School.

MAJOR LESLIE F. ZSUFFA is assistant transportation officer, Headquarters Second Service Command, U. S. Army, Governors Island, New York.

CHARLES I. PRESTON, who had been design engineer, Ranger Aircraft Engines, Farmingdale, L. I., N. Y., is now maintenance supervisor of trainer engines, Air Service Command, Patterson Field, Fairfield, Ohio.

WALDON RICE RHOADS, Vega Aircraft Corp., Lockheed Air Terminal, Burbank, Calif., has been assistant project engineer. He was control design engineer.

J. MITCHELL WATSON, on the metallurgical staff of the McCord Radiator & Mfg. Co., Detroit, has assumed his new duties in Washington as technical adviser to the Supply and Requirements Branch, Office of Civilian Supply, War Production Board.

John G. Lee

JOHN G. LEE, assistant director of research, United Aircraft Corp., East Hartford, Conn., and SAE vice-president-elect representing the Aircraft Activity, has written a book titled "Fighter Facts and Fallacies." His book, published by William Morrow & Co., visualizes clearly and simply the fundamental aerodynamics of fighter aircraft, and the author was generous in diagrammatic charts by Beverly Hancock showing the effect of various design features of pursuit aircraft.

JOHN M. THOME, formerly draftsman in the layout and design department of Fairbanks, Morse & Co., Beloit, Wis., is now with the Superior Engine Division of the National Supply Co., Springfield, Ohio, as layout draftsman.

BRADLEY G. KOHR has joined the engineering department of the McDonnell Aircraft Corp., St. Louis, Mo. Mr. Kohr had been an instructor of Aeronautical Engineering School, Engineering Drawing Kinematics, Parks Air College, Inc., E. St. Louis, Ill.

Formerly mechanical engineer at the Eclipse Aviation Division of the Bendix Aviation Corp., Bendix, N. J., **LARRY E. O'NEIL** is now with the Ruckstell-Burkhardt Mfg. Corp., Elmira, N. Y., as engineer.

Formerly engaged in designing jigs and fixtures for the Affiliated Engineering Co. in Detroit, **DAVID J. LITTLE** has left that position and is now employed as design engineer on lighter-than-air craft, Norman E. Miller & Associates, also of Detroit.

GEORGE KRIEGER, agricultural engineer, Ethyl Corp., Detroit, is now deputy director of WPB's Farm Machinery and Equipment Division, Washington.

Among the members of a special group of the Technical Committee on Alloy Steel of American Iron and Steel Institute, formed at the request of the War Production Board to investigate the merits of steels manufactured with special alloy addition agents, are: **HYMAN BORNSTEIN,** Deere & Co., **W. E. DAY, JR.,** Mack Mfg. Corp., **L. L. FERRALL,** Rotary Electric Steel Co., **A. W. F. GREEN,** Pratt & Whitney Aircraft, **H. B. KNOWLTON,** International Harvester Co., **JOHN MITCHELL,** Carnegie-Illinois Steel Corp., **R. B. SCHENCK,** Buick Motor Division of General Motors Corp., **HENRY WYSOR,** Bethlehem Steel Co.

JACK E. FRICK, who has been an engineer with the Vega Aircraft Corp., Burbank, Calif., is now flight test engineer, Lockheed Aircraft Corp., Burbank, Calif.

NORMAN F. WANGER, formerly engineer at the Gulf Oil Corp., Philadelphia, is now with the Rising Sun School of Aeronautics, Philadelphia, as engine instructor.

Formerly a designer in the Borg & Beck Co., Division of the Borg-Warner Corp., Chicago, **SAMUEL E. RUSINOFF** has joined the instructional staff of the Illinois Institute of Technology, also in Chicago.

Formerly assistant manager, **J. BYRON JONES** has been promoted to manager, the research and development department of Goodyear Aircraft Corp., Akron, Ohio.

CHARLES W. KYNOCH, formerly associate director, Engineering Division, U. S. Army Motor Transport Service, Office of The Quartermaster General, Washington, is now chief engineer in the Development Branch, Tank-Automotive Center, U. S. Army Ordnance Department, Detroit.

JAMES S. MACGREGOR, engineer of the New York Trust Co., New York City, is also consultant for various minerals branches of the War Production Board.

WILBUR FUSSELMAN completed his production engineer training and has been advanced to designer, the Titeflex Metal Hose Co., Newark, N. J.

EDWARD CHARLES McNEELY is tool supervisor of the Hoosier Engineering Co., Indianapolis, Ind. Previously Mr. McNeely was tool engineer with the Acme Pattern & Tool Co., Dayton, Ohio.

Formerly coordinator of inspection, U. S. Army, Philadelphia Ordnance District, **CHARLES O. GUERNSEY** has been transferred to the position of technical director.

ROBERT ANDREW OBENBERGER has left his position with the Chain Belt Co., Milwaukee, where he was an inspector in the gun shop, and is now supervisor at the McCulloch Engineering Corp. of the same city.

S. J. CHENEY has begun work as a design engineer in the Aircraft Engine Division of the Packard Motor Car Co., Detroit. He had been design engineer at the Triangle Engineering Co., Detroit.

MARTIN M. HOLBEN of the Wright Aeronautical Corp., Paterson, N. J., has been promoted from assistant project engineer to project engineer.

A. M. SWIGERT, JR., formerly master mechanic, Chrysler Tank Arsenal, Detroit, has joined the Ingalls Shipbuilding Corp., Pascagoula, Miss.

Managerial Engineers Exempt From Detroit Job-Freeze Plan

INTERPRETED for the first time for the *SAE Journal*, the word "worker" in the so-called "Detroit Plan" for freezing war jobs in the Detroit area does *not* mean every employee.

Engineers who have management responsibilities – as project or executive engineers – are exempt from the provisions.

If, however, a draftsman feels that he can perform more important work in the interest of war production, he may apply for a shift.

The Detroit Plan:

• Employers will refuse to hire or solicit workers from other essential industries within the area, unless the applicant presents a "certificate of release" from either:

His former employer, or

Review Unit, U. S. Employment Service (U. S. E. S.).

• Both the worker and employer will be notified of time and place for such review by U. S. E. S., and/or

• Notified of time and place of appeal, if any, before the War Manpower Committee. Either may be represented by counsel or spokesmen.

Circumstances calling for action:

• When an engineer thinks he is competent to perform work of higher skill than his present employer can or will provide, or

• When an engineer is on part time, or

• When an engineer lives at an unreasonable distance from the factory, or

• If an engineer has a "compelling personal reason" for making a change, or

• If an engineer is employed at a salary or working conditions *substantially* less favorable than those prevailing in the area for that type of work.

Seniority:

If an engineer is working at a job below his proved skill, or is working only part time, he may change his employment and maintain his seniority status with his former employer.

Maintaining seniority, however, requires compliance with detailed rules to be issued by the War Manpower Commission.

Procedures:

Engineers will use the facilities of U. S. E. S. instead of other existing employment services.

Employers are not to advertise, recruit, or scout for engineers outside the Detroit area, without obtaining clearance to do so from U. S. E. S.

War Manpower Commission will undertake an aggressive program for:

• Training,
• Reduction of absenteeism,
• Upgrading

Personnel

Montague Clark is the War Manpower Commission's district director in Detroit, and is the Government presiding officer

turn to page 53

IMPACT OF WAR ON INDUSTRY

Wilson To Use Present Staffs

DENYING Washington rumors that he intended building up a staff of production engineers to superimpose upon those now working on the nation's aircraft program, Charles E. Wilson, chairman of WPB's new Aircraft Production Board, told the *SAE Journal* that his function would be largely advisory.

He approaches what he calls "the biggest task I've ever faced" with the mind of a troubleshooter.

He plans to visit sources of production delays and look over the conditions himself. He expects to make decisions and to issue orders on the spot.

Among the organizations which will continue their functions are:

• The Aircraft Planning Committee (the former OPM and WPB Aircraft Branch) headed by T. P. Wright;

• The Working Committee of the Army and Navy Aeronautical Board;

• Standardization activities of the industry, such as the SAE Aeronautical Division: and

• Inspection and liaison officers of the Army and Navy assigned to manufacturing plants throughout the country.

"I believe that we have enough materials fabrication and processing facilities, and enough assembly plants and manufacturing establishments in the country to meet the 1943 and the 1944 aircraft programs," he said. "But we may have to rebuild or retool some existing plants from time to time to meet specific situations."

Mr. Wilson is also in charge of WPB's shipbuilding and radar efforts.

Cars-to-Scrap Outpace 1929 Car Output Rate

Since Feb. 1, automobile graveyards have converted nearly 4,250,000 cars into scrap to feed steel mills, at an annual monthly average greater than averaged 1929 production.

This scrap has been responsible for from 10 to 15% of the steel output.

Stocks in yards have already reached an all-time low of some 100,000, WPB's Scrap Processors Branch estimated.

War Output Disappoints

Nelson Reports Planes and Ships Down; Gains Are Low

OCTOBER production was disappointing to Donald M. Nelson, WPB's chairman.

Highlights of his report:

AIRPLANES: Production off 5%, as compared with September figures. This was due to bunching in September, and in one case poor flying conditions which delayed tests. Navy deliveries showed a gain, as did several of the "more useful" types. **ENGINE** shipments were up 4%, about three-fourths of which were for combat ships and one-fourth for trainers. **PROPELLER** shipments were up 11%. Alloy steel and aluminum shortages were reported by most of the manufacturers.

ORDNANCE: Up 3%, medium tanks off, but light tanks up. Material shortages were widely reported. Increase in spare parts for tanks and guns, required by combat experience, will compete more and more with tank and gun output.

NAVY AND ARMY VESSELS: Up 4%. Transport ship production declined, but landing boats and other small craft rose.

MERCHANT SHIPS: October production of 80 was 12 under September, but still ahead of schedule.

OTHER MUNITIONS: Up 9%.

MACHINE TOOLS: Gain of 2.4% over September.

NE Steels Revised

Higher Nickel Content In Scrap Raises Limits

INCREASES of nickel content in certain National Emergency (NE) Steel specifications were approved on Dec. 17 by the War Production Board, following a meeting with representatives of the Iron & Steel Division of the Society of Automotive Engineers and the Technical Committee on Alloy Steel of the American Iron & Steel Institute.

Average nickel content has been steadily increasing beyond the limits originally set by WPB for certain steels, because of:

- Influx of new nickel-containing scrap generated by the increased production of armaments, and
- Conservation measures adopted by mills.

The high nickel content of the scrap in recent weeks has often prevented alloy steel producers from bringing heats of NE steels within the specified compositions. Last minute switches of heats already in process were made to steels of higher specified nickel content, thereby complicating manufacturing procedures and delaying delivery.

This has frequently resulted in using more virgin nickel and other elements, such as chromium or molybdenum, than would have been necessary if the original intent had been to charge nickel scrap to produce the high nickel steels.

To make more efficient use of the alloying elements derived from scrap, the following revisions in the list of National Emergency steels have been made:

- All NE 8700 compositions have been deleted except NE 8720, which has been revised to read 0.40 to 0.70, an increase of 10 points in the upper limit.
- The following were also deleted: NE 8022, NE 8339, and NE 8949.

In requesting deletion of the NE 8700 series, WPB is attempting to conserve molybdenum and to make possible more flexible use of scrap generated in the steel mills.

- The NE 8600 series has been extended to compensate for the deletion of the NE 8700 series by the addition of these compositions:

NE 8635, NE 8637, NE 8640, NE 8642, NE 8645, and NE 8650.

The manganese content of those steels is 0.75 to 1.00%.

- The nickel content of all remaining NE 8600 series steels has been changed to read 0.40 to 0.70%, an increase of 10 points in the upper limit.
- In the same manner the nickel content of the NE 9400 series steels has been changed to read 0.20 to 0.50% and the NE 9500 series has been changed to read 0.40 to 0.70% nickel, in both cases an increase of 0.10% in the upper limit.

Representing the SAE Iron & Steel Division at the WPB meeting were Frank P. Gilligan, chairman, R. B. Schenck, E. O. Mann, and W. P. Eddy.

A new schedule of these steels is being prepared by the American Iron & Steel Institute, and is available at their offices at 350 Fifth Avenue, New York.

SAE Committees Created Background For Major War Alloy Specifications

BASIC work in developing wartime materials specifications, some of which have been issued by the War Production Board (NE Steels), and others adopted by the Army, Navy, and other Government agencies, was in many cases done years ago by SAE Standards and Research Committees, a survey of the field discloses:

- The most publicized has been the group of low-alloy steels, which stemmed from the SAE Steels and were modified by a WPB advisory committee including a number of outstanding SAE steel committee members. Close cooperation with the Technical Committee of the AISI, and the ASTM, groups long associated with the SAE in this type of work, brought quick results.
- Experience in aircraft materials was relatively small at the outbreak of the war, but for nearly a year before Pearl Harbor the SAE Materials & Processes Subdivision had been hard at work on a large series of specifications. Many of these had been approved by the industry and adopted by the Army and Navy before war was declared.
- Background of many years by SAE committees speeded the development of a series of National Emergency Non-Ferrous specifications, some of which have been adopted.
- Since World War I the SAE Ordnance Advisory Committee has been working closely with the Army Ordnance Department. Results of intensive research and experimentation, carried on jointly by the Army and the rubber industry under the aegis of this SAE group, was the basis of part of the testimony recently given to a congressional committee by William M. Jeffers, the new National Rubber Conservation Director.

The purpose of this type of emergency materials specification is to conserve critical materials. Hence the background of usable specifications is a vast amount of research and compilation of experience data on substitutions.

In this field the SAE has been particularly active through the SAE War Engineering Board. Its committees have furnished basic engineering data, at the request of Government officials, on substitution of materials for the United Nations' armament program:

- Rubber: Reports, mentioned above, submitted by committee of 15 members;
- Chromium steel alloys: Report submitted to Quartermaster Corps and WPB by its four members;
- Aluminum: Reports submitted to Army and WPB by three groups;
- Cork: Report on reduction and elimination submitted to WPB by its six members;
- Anti-freeze: Report of a proposed noncritical compound submitted to the Army, WPB, and Tennessee Valley Authority by its 15 members, following intensive laboratory and field testing.
- Copper: Three reports on different phases of copper substitution and elimination submitted to Ordnance, Quartermaster Corps, and WPB by its 10 members.
- Gasoline: Report on effect upon motor vehicles of reduction of octane number submitted to Office of Petroleum Coordinator by its eight members;
- Hydraulic brake fluid: Recommended specifications by its 11 members were adopted *in toto* by the Army;
- Mica: Study of available supplies and possible substitutions made in a report to the Ordnance Department and WPB. This project has expanded into aircraft equipment under another SAE committee, including some of the former members of the WEB group;

Another series of War Engineering Board reports attacked the problem of materials substitutions horizontally, i.e., by analyzing the following vehicles at the request of Army officials:

- Tanks (details are a military secret). The work was done by a committee of 12.
- 2½-ton trucks and larger: Report on possible substitutions for critical materials made to Army Ordnance and Quartermaster General by committee of 22;
- Half-track personnel carrier M3: Reports submitted to Army by committee of five;
- Half-track scout car M-2: Several reports submitted by committee of five;
- Scout car M3AL: Several reports submitted by this committee of five members.

Requests from the Army, Navy and civilian Government agencies are first received by the SAE War Activity Council, and are submitted to the proper committee for study and report. The Council has authority to create new committees to handle specialized studies whenever such are requested by the Government.

Ickes Gets More Power

The new Petroleum Administration For War, supplanting the Office of Petroleum Coordinator, is headed by Harold L. Ickes, former coordinator and Secretary of the Interior. His deputy administrator is his former aide, Ralph K. Davies.

Directly responsible to the President, Mr. Ickes has been given far broader powers than heretofore. They include:

- Issue and enforce orders regulating any phase of the petroleum industry, including their foreign facilities;
- Distribute to companies critical materials allocated to the industry by WPB;
- Supervise rationing of civilian supplies of petroleum; and
- Conduct and supervise research in production of petroleum materials for synthetic rubber.

A. I. Henderson In Army

World War II's veteran materials executive, A. I. Henderson, has resigned as deputy director for industry operations, WPB, to accept a commission in the Army. A captain during World War I, the New York attorney joined the National Defense Advisory Commission in July, 1940, and succeeded SAE Member William L. Batt as top man in the WPB Materials Division several months ago.

Wright Reports

Production Expert Lauds British Aero Engineers

LESSONS learned in combat are translated immediately into changed airplane design in England, T. P. Wright, SAE Council member and chairman of the U. S. Aircraft Production Mission to England, reported. He is chairman of the Aircraft Production Committee, and Deputy Director of the Aircraft Division of the War Production Board.

Mr. Wright was impressed with advanced aircraft engineering developments in England. He emphasized the need for "courage in projecting ahead the types of development which may contribute toward winning the war a year or two hence." Of the fighter planes now in production, he praised the Spitfire with its latest Merlin Engine, and the Mosquito. He spoke highly of the Lancaster bombers.

In describing British production, Mr. Wright found that output in terms of man-hours is somewhat less than in the United States. The factory set-up has been adjusted to the possibility of bombing, which, while lessening danger from enemy planes, reduces output.

The group visited underground factories, some just getting under way and others in efficient operation. Many small plants are located within a limited area, all feeding a few assembly plants. Large scale line production is difficult under these conditions, Mr. Wright said.

A factor limiting British production in terms of man-power is the relative obsolescence of British equipment as compared with our own. Single purpose machines, used here as part of assembly line technique, are less frequent in England.

The working day of aircraft labor is about 15% higher than here, and "it is possible that the intensity of labor effort is somewhat greater," Mr. Wright said. Workers in aircraft plants, he found, "are more aware of the actual meaning of war than are the workers in this country."

He found that the relations between labor and management are excellent. He said "the management at most factories seemed aggressive and appreciative of the responsibilities which they have."

Messers. A. G. Herreshoff, I. M. Laddon, Charles Marcus, J. Carlton Ward, Jr., and G. D. Welty are SAE members who were named to the Mission.

Tool Orders Redistributed

Reassignment of machine-tool orders to spread the backlogs of tool builders has been ordered by George H. Johnson, new director of WPB's Tool Division.

Certain companies with heavy orders that will take long to complete will have part of the load carried by other firms with less work on their books, he said.

Machine-tool production, he told the *SAE Journal,* had reached the all-time high of a monthly rate of $130 million, or double the rate of a year ago, and five times the rate of 10 years ago.

Lt.-Com. Blamphin Is Navy Member of Aero Board

Lt.-Com. A. M. Blamphin has been appointed acting Navy Member, Working Committee of the Aeronautical Board, succeeding Capt. G. A. Seitz, USN, who has been assigned to another tour of duty. Com. Blamphin has been the ranking assistant to Capt. Seitz. Col. D. G. Lingle, Army Air Corps, continues as Army Member.

War Cost

Curve Is Settling To Plateau Level

PRESENT estimates for U. S. war expenditures during 1943 will average about \$7¾ billion a month, as compared with something like \$6½ billion for December, 1942, and \$1.9 billion for December, 1941, and \$½ billion for December, 1940. The 1942 average monthly expenditure was about \$4 1/3 billion.

The 1942 estimated expenditures will be paid out at an average daily rate of about \$400 million as compared with the average daily rate of \$244,500,000 for November, 1942.

Thus the war expenditures of the nation will level off near the first quarter of the new year unless some huge increase in appropriations, unforeseeable now, is required.

Arms manufacturing has nearly caught up with materials available, Donald M. Nelson, chairman of the War Production Board, has said.

Use of critical materials for construction of military establishments and new factories is nearly ended. Thus more of the nation's productive capacity of steel and nonferrous materials will be diverted to armament manufacture.

New facilities will be coming into production for alloy steels, aluminum and other critical non-ferrous materials throughout the first quarter, dwindling as the year proceeds.

Army Air Forces Materiel Command

continued from page 24

ing officers of which report to Gen. Vanaman, are the:

- Eastern, in charge of Col. O. R. Cook, who graduated from the University of Illinois and the U. S. Military Academy in 1922. He was graduated from the Air Corps Engineering School in 1930, and the Tactical School in 1938. He is a Command Pilot and a Combat Observer.
- Central, in charge of Col. A. M. Drake. Enlisting in the Coast Artillery in 1915 as a private, he was promoted to corporal and then sergeant and switched to the Aviation Section, Signal Corps, and was commissioned a lieutenant in 1917, and a captain in 1918, when he was serving in France. He became commanding officer of the 1104th Aero Squadron and served as adjutant for the chief of the Training Section. He served as Supply Officer at Wright Field in 1927, when the Supply Division was moved there. He returned to France in 1931 to study aviation supply methods of the French Air Ministry, was assigned to the Canal Zone and in 1935 was appointed commanding officer of the 80th Service Squadron there. Graduating from the Army Industrial College in 1937, Colonel Drake was assigned to procurement tasks in Detroit. He later served as assistant procurement supervisor and later district supervisor at Dayton. He returned to Detroit in 1941. He is a Pilot and Combat Observer.
- Midwestern, in charge of Col. R. G. Harris, who attended Cooper Union, enlisted in the Navy in 1913, and enlisted in the Army in 1917. A year later he was commissioned a second lieutenant in the Air Service. He completed his course in military aeronautics, University of Texas, in 1918, served as a test pilot in 1921, and went to Hawaii in 1923 after completing several specialized courses. In January, 1929, he was engineering officer on the famed "Question Mark" on a record-breaking endurance flight. He was in charge of special equipment and remodeling of the airplane for that flight. He served as Air Corps representative at Douglas, Stearman, and Beech. He became assistant supervisor, Central Air Corps Procurement District, then at Wichita, and was control officer for the A. C. Ferrying Command there. He is rated as a Combat Pilot and Combat Observer.
- Western, in charge of Brig.-Gen. C. E. Branshaw, who served on the Mexican Border in 1916. When the United States entered the war, he enlisted as an aviation cadet, was commissioned a lieutenant, and was transferred to the regular Army in 1920. He served with the AEF in France. After service at various fields, he was appointed engineering officer at Brooks Field in 1924, became Operations Officer, Chanute Field, and served as assistant engineering officer at Luke Field, Hawaii in 1935. He was appointed commanding officer of the Hawaiian Air Depot in 1936. Returning to the United States, Gen. Branshaw has spent most of the time since 1938 on the West Coast.

Detroit Job-Freeze Plan

continued from page 51

(without vote) of the following Detroit Labor-Management Committee:

John L. Lovett, manager, Michigan Manufacturers Association; Frank Rising, manager, Automotive Parts & Equipment Manufacturers, Inc.; Willis Hall, manager, Industrial Department, Detroit Board of Commerce, and William J. Cronin, secretary, Manufacturers Committee, Automotive Council for War Production, all representing employers.

August Scholle, president, Michigan Council for Industrial Organization, Victor Reuther, assistant coordinator, War Policy Committee, UAW, CIO, George W. Dean, president, Michigan Federation of Labor, and Frank X. Martel, Detroit and Wayne County Federation of Labor.

Mr. Clark was formerly with the U. S. Rubber Co. as personnel and industrial relations executive.

The "Detroit Plan," Mr. Clark said, appeared to have been successfully introduced

turn to page 62

The Aeronautics Division of the SAE Standards Committee met during the Air Cargo Engineering Meeting. Standing, left to right: Charles McNeil, Aero Products; George Brady, Curtiss-Wright Corp.; William Littlewood, American Airlines, Inc.; Val Cronstedt, Pratt & Whitney Aircraft Division of United Aircraft Corp. Seated, left to right: C. E. Stryker, Aircraft Production Division, WPB; John A. C. Warner, secretary and general manager of the SAE; Mac Short, Vega Aircraft Corp.; Arthur Nutt, Wright Aeronautical Corp.; J. D. Redding, SAE; L. S. Hobbs, Pratt & Whitney Aircraft Division of United Aircraft Corp.; J. B. Johnson, Army Air Forces, Wright Field

continued from page 19

C. G. Peterson said in summarizing the experience of the Railway Express Agency in handling air express and by his comments on classes of commodities and merchandise moved by air. Air express in the U. S. totaled 5,242,529 ton-miles for 1941, he said, and for the first six months of 1942 the total was 4,738,985 ton-miles, an increase of 129% over the similar period of 1941.

Rate of increase in air express, Mr. Peterson declared, is keeping pace with the rate of increase in passenger revenue miles. No figure per ton-mile for l.c.l. air express or plane-load freight was available as yet, he said, citing 81½¢ per ton-mile as the gross air express revenue for all traffic in 1941. Gross revenue was $4,277,070, an increase of 40.5% over 1941. Total weight of shipments was 5620 tons and the average length of haul was about 935 miles, he pointed out.

Special commodity rates, cancelled now for the duration, have helped develop tonnage, Mr. Peterson stated, citing machinery, tools and parts as the top group, representing about 33% of the total air express in one particular month. Printed matter, store merchandise, films and matrices followed in order, he said.

Off air line business will increase with use of pick-up equipment, and great possibilities lie ahead, he said, in utilizing the more than 300,000,000 ton-miles of unused capacity of passenger plane routes, which figure is more than 60 times the air express and freight flown in 1941. Spreading direct flying costs over the combined passenger and freight plane capacity in ships designed for the task is fundamental in lowering ton-mile costs for the post-war period, Mr. Peterson declared.

Discussing handling costs, he explained how the use of magnesium roller conveyors in 200 of the company's terminals is saving loading time and described how three elevating means can be used for handling: portable elevators, trucks with elevated bodies, and inclined conveyors of the continuous-flow type.

Some Aspects of Air Cargo Operation in South America – J. PARKER VAN ZANDT, Office of Air Transport Information, U. S. Department of Commerce.

MR. VAN ZANDT, who has been active in domestic and international aviation for over two decades, during which time he has specialized in the study of Latin American aviation developments, told some amazing facts on the huge air cargo tonnage being handled by Latin American air lines. In that region, he said, the Taca air line alone in the last five years carried 93,000,000 lb of express and freight, which is over three times the total carried by U. S. domestic air carriers during the same period. And grouping the whole network of air operators in South America, he said the 77 operating lines handled more than six times the air cargo tonnage carried by the U. S. carriers. Explaining the special reasons for this, he pointed out that desert, mountain, and jungle areas form tremendous obstacles to surface transportation, which is forced to use round-about routes, whereas air routes are direct, saving enormous surface distances, even on the shortest routes.

This is shown by the fact that total mileage flown by South American lines is only 25% of that flown by U. S. carriers, he declared. Most significant, he said, is the deferred ("haul-when-we-have-space") principle for which rates are half, or less than air express rates (2½¢ per lb), which thus gives full plane loads, and gave one air line 60% of its revenues in freight tonnage.

Describing Taca, Scadta, Lloyd Aereo Boliviana, and Panagra operations, he explained de-Germanizing of major operations and progress of Panagra in inter-American operations. Great need now is for market research, he declared, in order to determine freight estimates for route extension. Some light will be shed on this subject in the book "The Struggle for Airways in Latin America," to be published by William A. Burden. Inter-continental frequency of service should grow, Mr. Van Zandt said, due to potential business of several hundred million pounds of freight and major passenger traffic. He cautioned, however, that competition is on a price basis and the air lines must be prepared to compete with surface transportation. Mr. Van Zandt illustrated his remarks by slides showing topography and routes of South American areas covered by air lines.

Economics of Post-War Carriage of Air Cargo – J. V. SHEEHAN, Manager, Industrial Research Div., Lockheed Aircraft Corp.

LOWER costs on transport of higher classes of surface freight and express through better planned equipment will be of paramount importance in the post-war period, declared Mr. Sheehan. Air line replies from a recent survey, he said, show that 83% of the carriers favor cargo-carrying facilities in passenger planes for the post-war period, particularly for transcontinental and transoceanic operation and even for feeder line service. For the lowest ton-mile costs, however, exclusive cargo planes are the ultimate goal. Larger combination planes, for the time being, will doubtless prove most practical during the initial stages of domestic cargo development, he declared.

Curves and charts showing the effect on ton-mile costs of different size planes with varying power units were then shown on the screen, emphasis being on the principle that the largest airplane operates at the lowest ton-mile cost. But he stressed the point that speed is another governing factor in cargo haulage. Where speed is of major importance, twin-engined planes are most efficient. A governing factor on four-engine shops is take-off weight, which must be limited, Mr. Sheehan declared, so that CA landing weight is not exceeded for short ranges. Curve characteristics show, he said, that the twin-engine plane has its best advantage under 250 miles and beyond that figure four-engined plane efficiency improves. At ranges of 500 miles, he showed that on a four-engine plane a 20-mile difference in speed affected operating costs about 5¢ a ton-mile, and on a two-engine plane, the same speed differential caused a cost differential of about two cents per ton-mile. Twin-engine planes are the most economical if size of payload does not exceed capacity of largest twin powerplants available.

DISCUSSION

Concensus of opinion among commentators was that aspects of cargo plane operation and tonnage available at paying rates are subject to such wide variation at present that no ideal solution is at hand. Best brains of the industry are needed, it was admitted, to explore much further the many underlying factors concerned. One speaker emphasized the need of formulating standards for a line of plane models for particular payload capacities, as, say, one to two tons for small models to use on small fields, two to

five tons for medium planes suitable for medium size fields, and 10 tons and over for large capacity planes, and at the same time planning the characteristics of each plane for the respective payloads and their handling with the greatest efficiency.

Comments were made on the possibilities of getting costs down to 10¢ per ton-mile with giant cargo planes and thereby attracting l.c.l. freight, but with 80¢ as the present rate, being identical with the passenger ton-mile rate, such a major cost reduction seems visionary, it was agreed. Use of roll doors as on South American planes was mentioned as a solution for larger size doors needed for loading. Experience of Army and Navy was cited as agreeing substantially with the combination plane idea. Experience of amphibian aircraft on South American lines favors use of land planes, even on strip or beach landing fields.

Among those participating in the discussion were Edward Warner of the Civil Aeronautics Board, Dr. Alexander Klemin of New York University, J. Parker Van Zandt, William A. Burden, and C. G. Peterson. A major contributor to the discussion at this session was Philip W. Amran, Chief, International Air Transport Division, Board of Economic Warfare, Washington, D. C., who suggested the eventual development of a line of transport plane models in various tonnage ratings as a development of our air transportation system. As a part of this system, he emphasized consideration of the deferred or space available basis of handling freight at lower rates as now used effectively by a number of South American air lines.

BANQUET PROGRAM

William Stout, Toastmaster

Chicago Section history was made again at this, the peak event of the two-day program, when a total attendance of over 400 was registered for the banquet session. At a speakers' table flanked by 25 aviation and SAE officials, and representatives of the Army and Navy, J. Howard Pile, Chicago Section chairman, introduced Mayor Edward J. Kelly of the city of Chicago, who spoke briefly on the importance of aviation and the growing prominence of Chicago as an air line center. Following an introduction of Section Committee chairmen responsible for handling arrangements on the meeting, Mr. Pile turned the meeting over to R. D. Kelly, general chairman, who introduced Mac Short of the Vega Aircraft Corp., Burbank, Calif., SAE presidential nominee for 1943. Speaking for SAE President A. W. Herrington, who was unable to be present due to a death in the family, Mr. Short extolled SAE's contribution to the war effort, in standards, specifications, and recommended practices relating to aviation, aircraft and other activities. He congratulated the Chicago Section on the masterly handling of the Air Cargo sessions and assured Section officers of the whole-hearted response by members and guests to the hospitality and cooperation of the Chicago Section.

Charles Froesch of Eastern Air Lines then placed a resolution before Chairman Kelly commending the SAE on its war activities. Following passage of the resolution, it was given to Arthur Nutt, chairman of the SAE Aeronautics Division and vice-president of the Wright Aeronautical Corp. to be forwarded to SAE headquarters. Chairman Kelly then introduced "Bill" Stout, president, Skycraft Corp., Detroit, toastmaster, who presented speakers from the armed services, Commander Schildhauer of the Naval Air Transportation Service and Col. Harold R. Harris, Army Air Transport Command.

Naval Air Transport Service – Com. C. H. SCHILDHAUER, Naval Air Transportation Service.

IN setting up the Navy Air Transport service for the transportation of men and materials, Commander Schildhauer said the practices of civilian air lines were followed to a large degree, declaring that the "know how" of air line methods has been of great value in extending Navy Air Transport to regular flying schedules of 40,000 route miles, using 95 transport aircraft. He told of the great utility of air cargo in emergency succor service at sea, citing a case of a submarine 10,000 miles at sea and in urgent need of a critical part. Four days after the notice was given, the part was being installed in the submarine and it resumed its patrol operations.

Importance of Air Cargo in the War Effort – Col. HAROLD R. HARRIS, Air Transport Command, Army Air Forces.

HOW far-reaching is the globe-circling operations of the U. S. Army Air Transport Command was revealed by Col. Harris when he declared that Army air world routes now total 60,000 miles, which compares with the 41,000 miles for all domestic airlines in the United States before the war. In one month, he said, the air transport command's ton-mileage aggregated larger than the combined totals of all the air lines in the United States during 1941.

A limiting factor in the service is handling of gasoline supply, the speaker stated, since the ratio of gasoline supply to payload over nonstop flights far exceeds that of any domestic operation. He welcomed SAE cooperation on this point to the end that air cargo may be released from the anchor of surface transportation. "I speak for Major-Gen. George and his entire command," said Col. Harris, "when I say to you SAE men that every one of you will regard our present operations as opening new fields for advanced aeronautical development. You in SAE have the same motto as the Air Transport Command 'The difficult we accomplish at once. The impossible takes a little longer.' "

DESIGN SESSION

Peter Altman, Chairman

Opening the Wednesday morning Design Session, Peter Altman, past-chairman of the Detroit Section, and 1942 vice-president for SAE Aircraft Engineering Activity, was introduced by Ray Kelly, general chairman. Prof. Altman, preliminary to introducing the speakers, emphasized the evolutionary character of airplane development and pointed out the need for a greater degree of specialized study on problems of airplane design.

Securing Means for Air Cargo – Col. E. S. EVANS, Evans Products Co.

LIGHTNESS with strength is vital in load fasteners for air cargo use, declared Col. Evans, who cited the case of Alaska-bound freight planes which carry fasteners weighing but 100 lb for the plane load. He told of the application of Evans Utility Loaders to auto loading of freight cars and explained how fasteners of a similar principle are used in engine haulage by plane. A group of 14 engines held down by this type fastener saved $77 per crate, eliminated weight, boxing and unboxing, achieving a total saving of $1176 per trip. Similar use in transport of plane engine production to point of installation will save about $2,500,000 per month, he declared.

Principle of correct load fastening is to permit no slack in the load, he said, and with engineered fasteners, packing and crating can be lightened. Slides were shown of hold-down application in converted planes to illustrate the methods used in fastening plane wings and tail sections.

Structural Materials for the Cargo Airplane – H. D. HOEKSTRA, Civil Aeronautics Administration.

ANALYZING standards vital to materials for plane design, Mr. Hoekstra discussed characteristics of aluminum alloys, wood, steel, stainless steel, magnesium alloys, beryllium, and composite

construction. He indicated that aluminum alloy materials are favored by us due to strength-to-weight ratio and familiarity of manufacturers with the fabrication. Specialized use of stainless steel because of its resistance to corrosion and its structural strength for specific design points will grow, Mr. Hoekstra declared.

Aircraft size, he said, will be established by considerations other than structures and their material limitations. Slides were shown by Mr. Hoekstra which plotted weight and strength factors of various materials and illustrated how their use in specific plane design introduced a number of engineering problems.

Airplane Design for Cargo Construction – CARLOS WOOD, Douglas Aircraft Co.

SIX basic factors governing cargo plane design, said Carlos Wood, are weight, drag, span, power, stalling speed, and handling time. Illustrating how these various factors affect plane performance by use of a series of slides, he said the big problem is to produce a design of good general utility that will also meet as far as possible special conditions of operation. Speed of replacement is the guide to delivery by air, he said, as against mass replacement by surface transportation. It is this factor that makes the plane preeminent for military use, he declared.

Coming cargo planes will comprise load compartments of the general dimensions of a freight car, said Mr. Wood, and improved means of handling, stowing, and dispatching cargo will be necessary. All of which emphasizes the need for flexibility of design for cargo stowage, he pointed out, and freedom from "freezing" of cargo size. Cargo compartments will have a flat floor and new plane design will reduce the distance from the ground to the cargo compartment.

DISCUSSION

Hold-down fasteners will eventually form part of the structure of the plane floor, declared Col. Evans in answering a questioner, and will help to give greater rigidity to the plane itself. Recent tests on army planes show proper loading methods save 48% of loading and unloading time, he pointed out. Dr. Klemin of New York University spoke of the fabrication advantages of wood and Mr. Hoekstra agreed that the extremely restricted nature of metal alloys at present had stimulated much interest in wood fabrication.

C. W. Morris of AiResearch Mfg. Co., Los Angeles, Calif., commenting on occasional failures of wooden wing materials where attached to metal ailerons while serving in the Panama Canal Zone, said it was due to the difference in expansion of materials as a result of extreme temperatures. Provision for 3/16 in. expansion through the use of vertical pins, he said, remedied the difficulty. On the same subject, George T. Page, Curtiss-Wright, St. Louis, Mo., said it was highly desirable not to weaken wooden parts by metal fittings. Magnesium alloys, he said, offer greatest possibilities for large planes and with fabrication by arc welding will produce the ideal structure for future plane design.

Edward Warner stressed the need for research on structure of the atmosphere in ascertaining stress on large surface areas of plane structure. Commenting on transoceanic flying boat developments, Mr. Warner gave one expert's appraisal of the future overseas ship as one having a fuselage big enough to require a pair of sea floats each the size of the liner Queen Mary. Other commentators were Carl de Ganahl of Fleetwings, Inc., and O. E. Kirchner of American Airlines.

CARGO GLIDER SESSION

C. P. Graddick, *Chairman*

The final session on Wednesday afternoon was reserved for papers on glider use in U. S. mail and Army service.

Air Pick-Up and Gliders as Related to Future of Air Cargo – RICHARD C. duPONT, All-American Aviation, Inc. (Paper read by Harry R. Stringer.)

FUTURE of short-haul mail and freight transport by air is based on utilization of a flexible pick-up system, it was pointed out in the paper prepared by Mr. du Pont. As evidence of this fact, Mr. du Pont cited the growth of his air-mail pick-up system to the point where it now covers 240 cities and 1400 additional pick-up routes have been applied for to the Civil Aeronautics Board. Daily schedules are maintained over these routes at a speed of 110 mph, picking up 50-lb loads. Extension of the pick-up principle to pick-up and delivery of loaded gliders offers great possibilities in reducing ton-mile costs, Mr. du Pont declared.

More capacity at lower operating cost can be obtained with freight-carrying glider tug combinations, he said, citing Germany's experience at Crete in the use of 3-engined glider tugs carrying 4200 lb pulling gliders of either 5300-lb or 2800-lb capacity. [Latest war news reports Germany using six-engined planes with gliders in moving troops to North Africa.] Mr. du Pont showed how in theory a DC-3 operating as a tug, pulling three gliders on a 400-mile route with three intermediate stops, could release a glider for each stop and cover the route at a cruising speed of 120 mph. At each point a glider could be released and one picked up, he said, giving service to and from terminals without intermediate landings.

Glider pick-up tests show such operations feasible, the author said, with a special advantage for the glider of landing at small size fields of local airports, providing thereby short haul pick-up and delivery service impossible by any other method.

Gliders for Transport – Major LEWIN B. BARRINGER, Chief, Glider Unit, Directorate of Air Support Headquarters, Army Air Forces.

PROPERLY designed tow planes and gliders used in ranges up to 1000 miles will be able to transport more cargo by air for less money and provide greater flexibility of pick-up and delivery than is possible by any other method, contended Major Barringer in a paper which outlined early experiences of his in glider tests, and which was concluded with his experiences with the armed forces in the use of motorless aircraft. The Army's CG-4A 15-place gliders are, he said, as large as a twin-engine transport or bomber and are being used at advanced glider schools in training Army glider pilots.

C-47 ships (Army version of Douglas DC-3) are used as tow planes and log-recorded data show, Major Barringer said, that with a 15-place glider in tow the combinations cruise at 120 mph. The gliders, however, are designed primarily for troop transport, he pointed out, and are not as efficient for cargo use, in his opinion, as gliders designed with higher wing loading especially for goods haulage. Yet tests on a 300-mile range, he said, show an increase of cargo capacity over that of the plane alone of 46%. For a range of 500 miles there was an increase of 50%, and for 800 miles, a gain of 59%. As the cost of the glider is but 1/6 of the plane cost, economy of the tug-plane method is clearly evident, he said.

DISCUSSION

In the discussion period, Harry Stringer emphasized that 95.6% of All-American's mail pick-up schedules were completed, utilizing blind flying and safety equipment methods prescribed by C. A. B. Ward C. Beeman of Lockheed Aircraft, Burbank, Calif., emphasized the landing speed problem as related to planes and gliders of great capacity to be built in the future. He cited a theoretical case of a 3,500,000-lb plane and commented on what an 80 mph landing speed would mean with such a ship. Dr. W. B. Oswald of the Douglas Aircraft Co., Santa Monica, Calif., discussed fueling of tug-planes in flight, and expressed the opinion that it was hard to excel a single plane in load performance, but conceded the plane and glider combination has definite use in military operations.

A specialized design treatment of gliders, whereby wings and tail could be removed, leaving a freight body on wheels which could function as a surface trailer for movement to shipper's dock, was an interesting possibility suggested by Dr. Miller of American Airlines, Inc. Peter Altman, Vultee Aircraft, pointing out lack of cu ft space in transcontinental planes for handling of flowers, foresaw use for gliders in the type of service where bulky but light loads could be handled by the addition of a glider.

Synthetic Rubber Production Beginning To Get Under Way

▪ Philadelphia

"Synthetic Rubber," by Dr. John R. Bates, Sun Oil Co., and "Rubber from Agriculture and the Publicker Alcohol Process," by C. L. Gabriel of the Publicker Alcohol Co., were the two papers presented at the Philadelphia Section on Dec. 9.

Before introducing the speakers, Chairman S. M. Cadwell, of the U. S. Rubber Co., listed the various synthetic rubbers, gave a brief resume of their properties, and compared them as to their suitability for use in automotive tires. "The natural product is, of course, superior to any of the synthetics at the present time," Dr. Cadwell pointed out. He said, however, that the situation in regard to availability, cost, and ease of manufacture has played a predominant role in the U. S. synthetic rubber program.

Dr. Bates introduced his paper with a discussion of the supply and demand of both the natural and synthetic products over the critical years 1942 through 1944. Quoting figures from the Baruch Report, he showed that the U. S., as of July 1, 1942, had a natural rubber stock pile of 625,000 tons, including both the new and the reclaimed product. "The quantity of synthetic material at that time was practically nil," he said. As the natural rubber is being used for essential needs, production of synthetics will begin to get under way, and in 1944 the total production of rubber of all kinds is planned to be 1,424,000 tons, of which only 68,000 represent the natural, and an additional 400,000 the reclaimed product. Dr. Bates quoted further the Baruch figures on the essential demand for rubber during these years, and showed that there will be no rubber, either natural or synthetic, for the average motorist during 1942 and 1943. What rubber he does get, will be of the reclaimed variety.

"By far the largest portion of the synthetic program is for Buna S rubber," Dr. Bates stated. This material is made by the polymerization of butadiene and styrene, the butadiene in turn being made either from petroleum gases such as butane, butein or ethylene or from alcohols. At the present time, he continued, it is planned to manufacture roughly two-thirds of the butadiene from petroleum, and one-third from alcohol.

Mr. Gabriel presented the other side of the butadiene picture, that is, butadiene "from agriculture and the alcohol process." Any starch- or sugar-containing material, he stated, may be used as a raw material for the production of butadiene from alcohol. He went on to say that nearly all of the synthetic rubbers manufactured in Europe used alcohol as the basic raw material.

The alcohol process as developed by the Publicker Alcohol Co. originated in Poland and was known originally as the Polish process. Alcohol is converted in the presence of a catalyst to acid aldehyde and then through various steps to butylene glycol. Butylene glycol, after dehydrating, produces the butadiene, which is then polymerized with styrene to produce Buna S rubber. Mr. Gabriel quoted figures on the cost of the alcohol butadiene plant. Each annual ton of capacity costs roughly $150, and the plant takes about eight months to build. In conclusion, Mr. Gabriel pointed out that "butadiene is the same product whether it is made from alcohol and agricultural products or petroleum gases."

In the discussion which followed the presentation of the papers the following point was brought out: Synthetic rubbers are less resilient than the natural product. In rolling over a road, the increased energy dissipation in the flexing of the synthetic tire builds up the temperature of the tire and adds to the rate of deterioration. This is partially overcome by using thinner side walls, which are made possible by the substitution of stronger rayon for the usual cotton cords.

Trainer Engine Must Be Simple

▪ Southern California

Mac Short, vice-president in charge of engineering, Vega Aircraft Corp., and 1943 nominee for presidency of the SAE, gave a brief talk on the subject of training, at the Nov. 13 meeting of the Southern California Section.

"Training is a never-ending program," he declared. "We must even train ourselves to train others."

The Bureau of Labor Statistics, he pointed out, says that by early 1943 there will be a shortage of some 6,000,000 workers in war industry, with the exception of some hundred thousand boys of pre-draft age. This gap will have to be filled almost entirely by women. Training women to design and draw up detail airplane parts, run stress analysis, and aerodynamic calculation, has not been extensive to date.

Many may ask what all this means to us and what we can do to aid in this training, Mr. Short continued. "First, it seems that those of us fortunate enough to have had the opportunity to develop our technical training in our specific business over a span of years should be tolerant of the trainee," he emphasized. "Second, we should recall the processes and mental anguish that we went through in our own lives and pass on our experiences to our associates," he continued. "Let's put the SAE facilities to work along educational and training lines today – pointing out to these new engineering workers the abundant fund of knowledge in the *SAE Journal*, the 'SAE

Handbook,' the Aircraft Engine Drafting Room Manual, the Standards, the Aeronautical Material Specifications, the Student Program, the meetings, such as this, to which they are welcome."

The expansion of the AAF primary training program was discussed by Major M. Malcolm, Headquarters West Coast Army Air Forces Training Center, Santa Ana, Calif. He stated that in spite of the accelerated schedule, the number of accidents per thousand hours of flying has been reduced to half that of 1934, when the expansion began.

The next speaker on the program was Charles P. Sander, chief engineer, Kinner Motors, Inc. Mr. Sander, in his paper, "Design and Development of a Trainer Engine," chose as his subject the Kinner engine, which powers the Ryan used by the Army and Navy, the Fleet Finch II used in Canada, the Howard used in the Civil Pilot Training Program, and others.

"A flyer's entire future in the air depends upon the confidence he gains in his first contact with the foreign element of flying," declared Mr. Sander. "His plane – and the engine that powers it – must be one that he can trust, one that will carry him with confidence to the big or complex ships that he later will fly."

Mr. Sander pointed out that a trainer engine must have reliability and ruggedness, first of all. It should be of simple design and lend itself to an ease of maintenance, and a minimum amount of time should be required for overhaul. It should be designed with as few parts as possible, with a view to long life and ease of repair, he said.

Mr. Sander explained that trainer engines are usually aircooled, either in-line or radial, for simplicity. He illustrated his talk with slides showing the engines.

See Picture of Actual RAF Raid

▪ *SAE Club of Colorado*

The SAE Club of Colorado held its Nov. 24 meeting at the Eberhardt-Denver Co., Denver. It was sponsored by Fred R. Eberhardt, who obtained a film from the War Department entitled "Target for Tonite," an actual filming of an RAF raid. After the picture was shown, the men were taken on a tour through the machine shop.

Brig.-Gen. A. R. Glancy

Tells of Decentralization Plan At War Engineering Board Dinner

Real authority to carry out a program of ever-widening decentralization has been given to the Tank-Automotive Center in Detroit by Chief of Ordnance Major-Gen. L. H. Campbell, members of the SAE War Engineering Board and of the working committees of that Board were told by Brig.-Gen. A. R. Glancy, Deputy Chief of Ordnance for Automotive on Dec. 10 at the Book-Cadillac Hotel in Detroit. General Glancy was the concluding speaker on a brief program following a dinner at which were gathered members of the W. E. B. and various W. E. B. committees and many officers concerned with the technical projects undertaken by the W. E. B. for the Ordnance Department.

The Ordnance Department, General Glancy emphasized, is aiming to get all possible jobs directly in the hands of industry and to reduce to a minimum the Ordnance personnel necessary to supervise and administer the Army ordnance war program. He praised the work of the automotive industry and complimented the SAE on its war program in general and on the work of the War Engineering Board in particular.

W. E. B. Chairman J. C. Zeder, chief engineer, Chrysler Corp., who presided at the meeting, expressed appreciation for the outstanding job accomplished by members of the far-flung W. E. B. committees and stressed their achievements as a practical example of the effective war-effort results obtainable by voluntary cooperation of capable technicians. Chairman Zeder read a brief message from his brother, Fred M. Zeder, vice-chairman of the board, Chrysler Corp., who was to have addressed the dinner guests but who felt unable to do so because of the very recent death of his father.

B. B. Bachman, chairman of the SAE War Activity Council, governing body of the entire SAE war effort, reviewed the development of the SAE war program and outlined its present scope, laying particular emphasis on the important work of the W. E. B. and its chairman. He gave large credit for effective establishment of the SAE war program to the early vision and prompt action of SAE General Manager John A. C. Warner before the middle of 1939 when the American preparedness program was still in its infancy.

C. L. McCuen, vice-president, General Motors Corp., voiced appreciation of the work of W. E. B. and its committees from the standpoint of industry and mentioned particularly the effective cooperation which the Ordnance Department has given to industry in development of war requirements.

He praised especially Gen. Campbell's recent request for suggestions from industry and the practical use which is being made by Ordnance of those suggestions after they have been submitted. About 40% of the suggestions so far made from industry, Mr. McCuen stated, turned out to be good enough to gain acceptance.

A restricted motion picture concluded the evening's program.

Superior Vehicle Performance Through Motor Fuel Tests

▪ Chicago

How directly related the progress of our on-rushing mechanized units in North Africa is to cooperative research between the automotive and petroleum industries was an important point explained by C. B. Veal, manager of the Cooperative Research Council, to members and guests of the Chicago Section at the Nov. 10 meeting at the Knickerbocker Hotel.

Mr. Veal indicated how superior performance of vehicles in desert operation has been achieved through motor fuel tests held by the Council under the auspices of the Quartermaster Corps. "Through these tests," said Mr. Veal, "we were able to determine the octane requirements and vapor locking characteristics of Army vehicles in desert service."

An abstract of Mr. Veal's paper is incorporated in the report of the Fuels and Lubricants Meeting in Tulsa, which appeared on pp. 22-30 of the November *SAE Journal*, and will be published in full in the February issue of the *SAE Journal*.

Members of the SAE War Engineering Board and its committees gathered for dinner on Dec. 10 in Detroit. In attendance also were a group of Ordnance officers, headed by Brig.-Gen. A. R. Glancy, Deputy Chief of Ordnance for Automotive. Taken just prior to the dinner, this picture shows (left to right): B. B. Bachman, vice-president, The Autocar Co., a member of the War Engineering Board and chairman of the SAE War Activity Council; Brig.-Gen. A. R. Glancy, and J. C. Zeder, chairman of the War Engineering Board and chief engineer of the Chrysler Corp.

SAE Aero Material Specifications Reach 283, With Nearly 1,250,000 Copies Sold To Date

SINCE February, 1941, when the Society of Automotive Engineers' Aeronautical Materials Specifications (AMS) Committee set-up was reorganized, 147 new specifications have been prepared, approved, and issued, and 130 specifications have been revised during the same period. There are now available 283 specifications in the AMS series covering materials used by the aeronautical industry, including the aircraft engine, propeller and accessory, and airframes manufacturers.

Nearly 1,250,000 copies of the AMS have been purchased for use throughout the aircraft industry. These have been distributed to 3000 different purchasers and users.

New Group Added

During the past year, the Aircraft Accessory Materials and Processes Committee has been organized under the chairmanship of Dr. N. E. Woldman of Eclipse Aviation Div., Bendix Aviation Corp., Bendix, N. J. Needs and requirements of the accessory manufacturers are receiving appropriate consideration by the committees at the time of preparation of the specifications, and the specifications are consequently more readily acceptable to the aircraft accessory manufacturers.

Complete Industry Representation

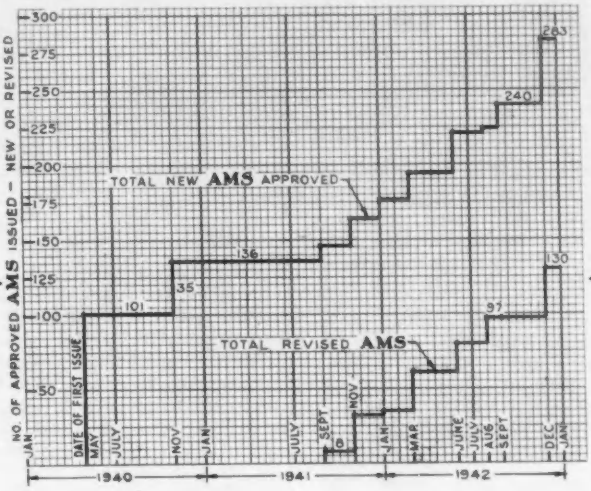
There are 35 key metallurgists from the airframes, aircraft engine, propeller and accessory manufacturers' plants and the Army and Navy serving as members of the three committees whose work is coordinated by this subdivision.

The committee has cooperated extensively during the past year with the WPB Technical Advisory Committee for Aeronautical Steels. The material users' representatives on the WPB Committee were selected from members of the SAE Committee. Following the issuance of the WPB report recommending a list of alternate steels, a series of 16 Aeronautical Material Specifications covering the compositions recommended by the WPB were prepared and issued in tentative form to the industry on May 5. Based on the experience in testing these steels, following that date the committee members reported favorably on these steels at the Denver meeting, and as a result the 16 AMS Specifications for these aeronautical alternate steels were approved and issued as of Sept. 1.

Synthetic Rubber Specs

During the past six months, the Committee has been actively engaged, with the cooperation of the synthetic rubber producers and vendors, in developing a series of AMS Specifications for synthetic rubbers. There has been a great demand for such standard specifications throughout the industry, as there were no satisfactory specifications available. Twenty-four specifications covering the different types of synthetic rubber required by the airframes, aircraft engine, propeller and accessory manufacturers have just been completed and, after approval by the Aeronautics Division, were published as of Dec. 1, 1942.

The SAE recently received a request from an allied nation for permission to reproduce the AMS in that country in order to facilitate their prompt use by industry in that country, and the Society has granted permission.



UNDER the chairmanship of J. B. Johnson, Materiel Center, U. S. Army Air Forces, the **SAE Aircraft Materials and Processes Coordinating Subdivision** is divided into three committees.

Serving with Mr. Johnson on the administrative committee are:

L. D. Bonham, Lockheed Aircraft Corp.; B. Clements, Wright Aeronautical Corp., and Dr. N. E. Woldman, Eclipse Aviation Division, Bendix Aviation Corp.

The three committees are:

Aircraft Engine Materials and Processes Committee, headed by Mr. Clements. There are 16 members serving on this committee.

Airframes Materials and Processes Committee, of which Mr. Bonham is chairman, with a membership of 17, and

Aircraft Accessory Materials and Processes Committee, headed by Dr. Woldman, with nine committee members.

Personnel from the following Government agencies and manufacturing companies serve on the above committees:

Allison Division, General Motors Corp.,
Aluminum Co. of America,
American Propeller Co.,
A. O. Smith Corp.,
Bell Aircraft Co.,
Bendix Products Div., Bendix Aviation Corp.,
Boeing Airplane Co.,
Bureau of Aeronautics, U. S. Navy,
Civil Aeronautics Administration,
Consolidated Aircraft Corp.,
Curtiss Airplane Division,
Douglas Aircraft Co.,
Eclipse Aviation Div., Bendix Aviation Corp.,
Fleetwings, Inc.,
Ford Motor Co.,
Glenn L. Martin Co.,
Hamilton Standard Propellers,
Henry Souther Engrg. Co.,
Jacobs Aircraft Engine Co.,
Lockheed Aircraft Corp.,
Lycoming Div., The Aviation Corp.,
Materiel Center, U. S. Army Air Forces,
Naval Aircraft Factory, U. S. Navy,
North American Aviation, Inc.,
Packard Motor Car Co.,
Pratt & Whitney Aircraft,
Ranger Aircraft Engines,
Republic Aviation Corp.,
Sperry Gyroscope Co.,
Thompson Products, Inc.,
Vought-Sikorsky Aircraft,
Vultee Aircraft,
Wright Aeronautical Corp.

ODT Chief Presents Plan For Training of Workers

▪ *Pittsburgh*

"The first World War brought about an acute shortage of trained mechanics and provided the necessity for rapid group training programs in a wide variety of manufacturing enterprises," said William J. Cumming when he spoke before the Pittsburgh Section on Nov. 24. Mr. Cumming, who is chief of the Vehicle Maintenance Section, Office of Defense Transportation, said that the situation today, expanded far beyond that of 1917, is even more critical.

Following the first war, many who had participated in group training experiments continued to make use of a number of the methods discovered during the emergency period, he continued. Many of these methods outlived the war period because they proved exceptional in building morale in any organization, and were adaptable to practically all industrial activity, large or small.

Morale Building Rules

Mr. Cumming listed three rules used to build morale in assembling working personnel: Every worker should start from a common level; every worker should be given identical training; and every worker should be assured of advancement according to opportunity and personal ability to learn.

"As far as the mechanical training features were concerned," said Mr. Cumming, "the mass instruction plan was identical to the modified scheme, and developed into four distinct steps or phases:

1. Preliminary instruction of entire working group,
2. Division into small groups, selected according to ability,
3. Training of small groups by working instructors,
4. Advance instruction for supervisory force and working instructors.

Groups Should Be Graded

Mr. Cumming suggested that the most simple mechanical devices be presented to the group first, and that, as the classes proceed to the more complicated subjects, an effort should be made to grade the group. The class will undoubtedly contain all types of mind and some individuals will not progress beyond the first few problems. But since all types are required for the working organization, there need be no pressure exerted to teach more than each man is able to absorb.

"Some parts of the instruction may take the form of practical or operating demonstrations of devices, accompanied by oral instruction, and others may be almost wholly oral instruction followed by an explanation of the functions of each part of the whole device," explained Mr. Cumming. "In all cases," he added, "the unit under discussion, or a model or mock-up, should be displayed for inspection and handling by the group."

In the discussion which followed the presentation of Mr. Cumming's paper, Carman Smith, acting area division manager, War Manpower Commission, said there are three possible answers to the problem of where to get the personnel to train which would give from one to three years of service to justify the time spent in training them: (a) Start with boys of 16 years and up as helpers and apprentices; (b) use older men of over 45 years, although they are generally more set in their ways and less adaptable to training than younger boys, and (c) use more women in industry.

Wallace Hallam, Mack International Motor Truck Corp., said he had been trying to locate manpower which would be subject to mechanic training. In the absence of a directive from Washington as to the vital importance of truck and bus transportation, this is difficult, he declared.

Mr. Cumming replied that the trend is toward the recognition of the importance of heavy-duty truck and bus industry – because many factories are almost entirely dependent upon truck and bus transportation for materials and men – and the importance of keeping the automobile mechanic in the automobile industry.

"The Pittsburgh school system is ready and willing to train men for the heavy-duty truck and bus industry and automobile dealers," pointed out Thomas P. Kenney, War Manpower Commission, "although the products of these schools would not be all-around mechanics, but rather trained in the basic fundamentals of electrical and mechanical trades."

The problem of getting the Office of Defense Transportation to recognize heavy-duty trucking as an essential industry was brought out by B. H. Eaton, Bell Telephone Co.

Discussing the assertion that it takes twice as long for older men to learn new jobs, Murray Fahnestock remarked that this might apply to older men who had never been employed, but it is largely an individual question, for most companies are headed by older men who are as quick to grasp ideas as younger men. The point was brought out, however, that most of the older men now available for mechanic training are not just over 45 years of age, but range from 55 to 65 years.

Today's Maintenance Pinch To Bring Post-War Compensations

▪ *Philadelphia*

"Symposium on Truck Maintenance in War Time" was the topic for the evening at the Philadelphia Section's Nov. 11 meeting. W. J. Cumming, chief of the Maintenance Section, Division of Motor Transport, Office of Defense Transportation, and chairman for the evening, read his paper, "Highway to Victory," before introducing the other speakers. This paper was published in full in the December *SAE Journal*, p. 15.

Through the lack of new equipment, maintenance men are on their own with respect to keeping the wheels rolling, he said. As a result of this situation, he continued, maintenance as construed by fleet operators is now an exact science, calling for the best in each man in the way of knowledge and skill.

Mr. Cumming predicts that all truckmen will be better buyers because now, from the superintendent down, they will know their trucks inside out. The salesman of the future will probably be a technical man who knows his truck throughout and the facts behind its design. He believes that there will be a loss of eye appeal, with resulting greater accessibility to all working parts and adjustments. Furthermore, the manufacturer will have new basic materials which probably will result in lighter truck weights and higher pay loads. Experience gained in the Armed Forces will result in other changes, he said.

D. B. Erminger, chairman of the SAE T&M Committee "Reconditioning Cylinder Blocks and Fitting Sleeves," reported on the findings of the committee.

It is the committee's opinion, he reported, that the practice of salvaging and reconditioning cast en bloc engines by installing dry type cylinder sleeves is entirely practical and advisable when any of the following conditions exist: The diameter of oversizing required for gaining concentric bores is either greater than manufacturer specifications or requires removal of more than 0.0625 in. of metal from the bore; deeply scored or cracked walls; porosity of metal is such that leakage is visible. Mr. Erminger stressed the importance of proper preparation of the block for the sleeves, with particular attention being paid to the machining of the block and the proper fit of sleeve to the block, which is dependent upon the type of sleeve used.

Cold Welding

The subject of "Cold Welding" was E. H. Blakelock's contribution to the symposium. Although at present the cold welding method is of a somewhat secret nature, and specific information as to method or materials cannot be divulged, he did state some of the specific repairs possible with cold welding. Among them are valve seats, heads, freeze cracks, heat cracks and in the base of "V" type engines.

The last speaker of the evening was Henry L. Brownback, who discussed the results of a survey made by a T&M committee on "Engine Temperature Control." He pointed out that an engine can run either too hot or too cold, an accepted example being the behavior of alloy bearings which will corrode under extremes in either direction. The survey indicated that more oil breakdown was obtained under cold conditions than hot through dilution and extraneous dirt, he disclosed. In the majority of cases, the corrective measures for this condition are better thermostatic control and better ventilation. In conclusion, Mr. Brownback said that more attention should be paid to temperature control of an engine, since not only a decrease in maintenance results, but also an increase in efficiency of operation.

Discuss Lockheed's Winter Project for AAF

▪ *Texas*

Don Marshall, Southwestern manager of the Lockheed Aircraft Corp., conducted a special program highlighted by an off-the-record discussion of Lockheed's winterization project for the Army Air Forces, at the Section's meeting of Nov. 13. Robert C. Pote, engineering supervisor for the project, was speaker, and Roy Dickson, a Lockheed test pilot who formerly operated with the Star Air Line in Alaska, showed color movies of flight operations in the far north in temperatures as low as 65 deg below zero.

Bert Hall, last survivor of the original Lafayette Escadrille, who once commanded the National Chinese Government's Air Force, was a guest.

The Section plans to have Col. John H. Jouett, of the Higgins Aircraft Corp., as the principal speaker at the January meeting.

Glenn L. Martin's Dreams Come True

▪ *Baltimore*

R. B. Gray, director of the Glenn L. Martin Laboratory, and who has been associated with Glenn L. Martin for 24 years, presented an informal talk at the Nov. 12 meeting of the Baltimore Section.

With slides to illustrate his story, Mr. Gray told how in 1908 Mr. Martin rented an abandoned southern Methodist Church and laid out the assembly room for his first airplane. Thus, the Glenn L. Martin Co. was born – not as a company, but as a man.

Mr. Gray showed the Martin airplane of 1909, powered with a 30 hp Eldridge engine. The wing covering was of muslin, bamboo was used for tail booms and outriggers, fine spruce was used for the central structure and wing supports – but it did fly.

By 1919 Mr. Martin had taken to barnstorming to expand his dream and to finance his plane-building enterprise. And in this same year the Glenn L. Martin Co. of Santa Ana, Calif., was incorporated. In 1913 Mr. Martin built a forerunner of our modern pursuit plane – it was armor clad. The Los Angeles Times said in 1913: "What is declared to be America's largest airplane company is to be located here today when the factory and offices of the Glenn L. Martin Co. are moved to their new location. . . ." In this same year, the fledgling company delivered its first airplane to the Army. In the years following the company produced airplanes for Holland and the Netherlands East Indies, as well as the United States.

Mr. Martin erected a plant in Cleveland in 1918, and then followed a period of expansion and production. In 1932 Mr. Martin was presented the highest award in American Aviation – The Collier Trophy – in recognition of the production of a bimotored, high-speed, weight-carrying airplane.

Mr. Gray quoted from a wire received on Jan. 5 of this year from The Ministry of Aircraft Production: "In the second Libyan campaign 13 enemy aircraft including nine Messerschmitt 109's were downed by one 'Maryland' squadron. . . ." The Maryland is Model 167.

It was in Model 187, known as "The Baltimore," that a world record was shattered when, in a dive, a speed of more than 600 mph was attained in a twin-engined bomber.

"Builders of Dependable Aircraft Since 1909," Mr. Gray said, is a simple but well-known note which everyone is accustomed to reading in Martin advertisements.

R. B. Gray, who told the story of the origin and progress of the Glenn L. Martin Co. to the Baltimore Section of the SAE. Mr. Gray has been associated with Glenn L. Martin for 24 years

A Naval Inspector's Work Covers Wide Range

▪ *Northern California*

Lt. Lloyd H. Mulit, USNR, petroleum officer, Office of Inspector of Naval Material, and Dr. Robert G. Larsen, Shell Development Co., were the speakers at the Nov. 10 meeting.

Lt. Mulit's paper, "The Function of the Naval Inspector in Time of War," reviewed the history and function of the Naval Material Inspection Service. At first the duties of this branch of the Navy were confined primarily to inspection of ships and a few naval stores, he said, but now anything from gingham for South Sea Island natives to immense and mechanically complex battleships is inspected.

In addition, the inspector must be familiar with material shortages so he can have specifications changed to permit use of satisfactory substitute materials; he must be familiar with manufacturing procedures so that alterations which speed production without sacrifice of quality can be approved; he must know the priority system so that necessary material can be assembled on schedule; he must follow technical developments so that specifications may be altered when required to permit the use of new methods of manufacture which are better or faster than those in use.

The Navy inspector is the producer's representative to the Navy, he pointed out, and the Navy's representative to the producer.

Stability of Crankcase Lubricants

Dr. Larsen's paper dealt primarily with one aspect of the lubrication problem – stability of crankcase lubricants to oxidation. The chemist considers the internal-combustion engine primarily as a reaction chamber, he said. Therefore, in approaching the problem, a very careful analysis of fresh and used oils was made.

A study of the commercial type lubricating oils indicated that small amounts of material inhibitors exist which appreciably improve the stability of the lubricating oil stocks, Dr. Larsen continued. Unfortunately, these natural inhibitors are frequently closely associated with undesirable components, and it is sometimes difficult to refine or treat the oil stock in such a way that the natural inhibitors may be retained.

The analysis made in the used stocks was directed toward the identification of the undesirable compounds existing in the used oil. The catalytic effect of the different component portions of the used oil was measured by determining the time required for a given degree of oxidation on a fresh oil sample to which had been added a small amount of the used oil component. Using this procedure, it was found that certain compounds, such as the ferric or ferrous halides, are very active in the promotion of oxidation.

Dr. Larsen concluded his paper with data showing the effect of filters on the oxidation of the crankcase oil. This data indicated that the filter tended to extend the life of the oil from an oxidation standpoint, although it had definite limitations, particularly in the case of soluble oxidation-promoting compounds.

Practical Application of Electronics Is a Reality

▪ *Mohawk-Hudson Group*

The speakers for the Nov. 10 meeting of the Mohawk-Hudson Group were A. E. Bailey, Jr., and W. C. Hutchins, who are both engaged in electronics work at the General Electric Co. "Electronics in the Automobile Industry" was the subject of their joint talk.

Mr. Bailey, who spoke first, pointed out that the application of electronics in industry is by no means something to be looked for only in the future, but an actual reality at the present time. However, he added, there is the future possibility of radical improvements in many types of industrial machines even though at present, due to war conditions, it is necessary to stick to practical applications on existing machines.

Examples of electronic devices now being used in the automotive industry are welding controls, controls for variable speed machine tools, controls for conveyer systems, and highway lighting. Headlight testing is done electronically and also automatic traffic counters and speed cops on the highways are activated by the vacuum tube, he said. These are just a few electronic devices – some are military secrets and still others are so revolutionary that the present crowded work schedules and material shortages do not allow their application to industry.

Operating Principles Described

The operating principles of electronic devices and many practical applications were described by Mr. Hutchins. Their use in color standardization has enabled car manufacturers to make bodies in one plant, fenders in another, and yet be sure of a perfect match when the two are brought together in final assembly. In a high speed rolling mill, Mr. Hutchins said, it is possible to maintain correct thickness through the use of electronic thickness gages. In engine testing, he added, pressures can be measured far more accurately than with ordinary gages, enabling engineers to determine instantaneous fluctuations not previously discernible.

The dinner and meeting were held at Union College under the sponsorship of Prof. R. L. Stanley, Group meeting chairman.

continued from page 53

within the first few days. He was enthusiastic about its reception, the cooperation of both management and labor, and his committee.

Paul V. McNutt, War Manpower Director, told the *SAE Journal* in Washington that such plans as the Louisville and Detroit schemes would be put into operation only in areas where there was a critical manpower problem.

He expected to ask Congress for legislation to strengthen the U. S. E. S., which has suffered serious turnover in operating personnel because of the low pay range provided heretofore.

SAE Member Heads WPB Priorities

B. C. Heacock, chairman of the executive committee, Caterpillar Tractor Co., and an SAE member, has been appointed director of the Priorities Control Division, Distribution Bureau, of the War Production Board.

J. A. Krug, WPB's deputy director general for distribution, in making the appointment told the *SAE Journal* that Mr. Heacock's division is charged with the responsibility of "integrating the Production Requirements Plan (PRP) and the priorities system as a whole, with the new Controlled Materials Plan (CMP)."

It will implement the determinations of the WPB Requirements Committee, on which are representatives of the Armed Forces and other Government agencies. It will process applications for special and emergency ratings, and will clear all WPB orders.

Alloy Steels Get Tighter

Despite a tapering off of demand for structural steels and reinforcing bars, with the completion of the major portion of the emergency facilities construction, alloy steels are getting tighter than ever, Hiland G. Batcheller, director of the new WPB Steel Division, warns.

Numerous limitation and conservation orders have been effective, he said, in reducing non-military uses of steels, but the demand for alloys for aircraft and other munitions continues to rise, and will do so until new alloying facilities come into production.

Five Firms Join In Rubber Venture

The National Synthetic Rubber Corp., organized by five independent rubber manufacturing companies, will operate the proposed rubber plant to be built by the Government in Kentucky. They are:

Goodall Rubber Inc., Trenton; Hewitt Rubber Corp., Buffalo; Hamilton Rubber Mfg. Co., Trenton; Lee Rubber & Tire Corp., Conshohocken, Pa., and the Minnesota Mining & Mfg. Co., St. Paul.

The plant will be completed in June.

Stainless Recovery Program Accelerated

More than 30,000 tons of stainless steel and products of these alloys will be recovered from idle and excess inventories soon, WPB announced.

The Steel Recovery Corp., a subsidiary of the Reconstruction Finance Corp., has mailed inventory forms and price schedules to thousands of known holders of such materials. The corporation is staffed with steel industry men, and is headquartered in Pittsburgh.

Rotate Deliveries

The entire area served by four florists in Dallas, Tex., will be divided into four delivery districts, and each dealer will be assigned to a single district on a given day. Each dealer then will make all deliveries, his own and those of the other three dealers, in the district to which he is assigned.

These districts will be rotated so that each dealer will be assigned to a different district each day, thus equalizing the mileage traveled by the trucks of all four dealers.

Rubber Plant Boss

Frank R. Creedon, a veteran Government construction engineer, is in charge of the WPB rubber plant program. Formerly chief engineer of the Office of the Chief of Army Engineers, he was in charge of the building program of Army munitions plants.

He was made assistant deputy rubber administrator by Director William M. Jeffers.

SAE Coming Events

Jan. 11-15 1943 — **SAE War Engineering Production Meeting (SAE Annual Meeting) Book-Cadillac Hotel—Detroit, Mich.**

Baltimore – Jan. 14

Engineers Club; dinner 6:30 p.m. Luminescent Coatings – Dr. G. F. A. Stutz, assistant chief, Research Division, New Jersey Zinc Co. of Pa.

Canadian – Jan. 20

Royal York Hotel, Toronto; dinner 7:00 p.m. "A Vision Fulfilled" – Canadian Production of Alloy Steels for War Purposes – Harold B. Chambers, metallurgist, Atlas Steels, Ltd.

Chicago – No meeting

Cleveland – Jan. 4

Cleveland Club; dinner 6:30 p.m. Aircraft Testing and Maintenance Procedures – M. B. Crawford, sales engineering and service manager, Pump Engineering Service Corp.

Colorado Club – Jan. 20

Denver. Engines of War – George N. Gromer, Mountain States Tel. and Tel. Co.

Indiana – No meeting

Milwaukee – Jan. 8

Pfister Hotel; dinner 6:30 p.m.

Metropolitan – Jan. 21

Hotel Edison, New York City; dinner 6:30 p.m. Aluminum, Plastics and Other Materials for the Car Future – Frank Jardine, chief engineer, Castings Division, Aluminum Co. of America.

Northern California – Jan. 12

Hotel Leamington, Oakland; dinner 7:00 p.m. Future Trends in Engineering. Technical Chairman – Prof. L. M. K. Boelter, University of California.

Oregon – Jan. 15

Lloyds Golf Course, Portland; dinner 6:30 p.m. Aluminum Industry – C. S. Thayer, superintendent, Aluminum Co. of America Vancouver, Wash., Plant.

St. Louis – Jan. 22

Joint meeting with ASME Influence of Machine Design on Lubrication – W. G. G. Godron, chief engineer, Socony-Vacuum Oil Co.

Southern California – Jan. 8 and 22

Jan. 8 – Victory Room, Clark Hotel, Los Angeles; dinner 6:30 p.m. Subject – Aircraft Materials. Meeting Chairman – T. D. MacGregor, liaison engineer, Douglas Aircraft Co., Inc., El Segundo Plant.

Jan. 22 – Victory Room, Clark Hotel, Los Angeles; dinner 6:30 p.m. Subject – Passenger Cars. Meeting Chairman – Carl Abell, field engineer, Ethyl Corp.

Washington – Jan. 12

Speaker: Brig.-Gen. G. M. Barnes, chief, development branch Ordnance Department.

APPLICATIONS Received

The applications for membership received between Nov. 15, 1942, and Dec. 15, 1942, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section

Lind, Arthur M., Corp., U. S. Army, instructor, Company C. Headquarters Battalion, O.R.T.C., Aberdeen Proving Ground, Md.

Ryan, John T., senior industrial specialist, automotive branch, truck section, War Production Board, Washington, D. C. Mail: 914 Argonne Drive, Baltimore.

Buffalo Section

Chrzan, Theodore J., technical service department, Clark Bros. Co., Inc., Olean, N. Y.

Canadian Section

Gaskin, Denis Clement, vice-president, Studebaker Corp. of Canada, Ltd., Windsor, Ont.

LaLonde, Edwin C., secretary-treasurer, Federal-Mogul Service, Ltd., Toronto, Ont.

Richards, Ross L., sales manager, Prestolite Storage Battery Co., Toronto, Ont.

Wilkes, Horace, manager, tire division, Gutta Percha & Rubber, Ltd., Toronto, Ont.

Chicago Section

Breer, Carl Frederick, production test engineer, Dodge Chicago Plant, division of Chrysler Corp., Chicago.

Jacobson, Walter E., chief checker, The Buda Co., Harvey, Ill.

Johnston, E. H., chief metallurgist, Standard Forgings Corp., East Chicago, Ind.

Owens, Richard Harrison, chief model test engineer, Dodge Chicago Plant, division of Chrysler Corp., Chicago.

Pope, Hugh, assistant sales manager, National Malleable & Steel Castings Co., Cicero, Ill.

Cleveland Section

Balogh, Roy O., mechanical engineer, Weatherhead Co., Cleveland.

Beckwith, Rexford P., inspector, U. S. Army, War Department, Cleveland Ordnance District, Cleveland.

DeGraff, Wilbur C., manager, sales engineering, Warner & Swasey Co., Cleveland.

General Tire & Rubber Co., Akron, Ohio.

Glick, Julius L., president and general manager, Truck Engineering Corp., Cleveland.

Hill, James Donald, production department, Weatherhead Co., Cleveland.

Jardine, Robert, engineer, Twin Coach Co., Kent, Ohio.

Jarosh, Rudolph, tool room foreman, The S. K. Wellman Co., Cleveland.

Longstreet, James Russell, design engineer, Warner & Swasey Co., Cleveland.

Novotney, Thomas A., laboratory manager, The S. K. Wellman Co., Cleveland.

Pattison, Donald M., sales manager, Warner & Swasey Co., Cleveland.

Paetz, Robert A., methods engineer, Thompson Aircraft Products Co., Cleveland.

Romine, George Lohman, service engineer, The S. K. Wellman Co., Cleveland.

Rupp, Herbert E., vice-president, The Gorman-Rupp Co., Mansfield, Ohio.

Savage, Paul M., secretary, McGean Chemical Co., Cleveland.

Seiberling Rubber Co., Akron, Ohio.

Webber, George DeWilton, senior partner, Webber Gage Co., Cleveland.

Detroit Section

Akinci, Mustafa A., draftsman, Regal Engineering Co., Coldwater, Mich.

Baer, Howard C., dynamometer operator, Detroit Diesel Engine Division, General Motors Corp., Detroit.

Baker, Lee Robert, director of graduate school, Chrysler Institute of Engineering, Chrysler Corp., Highland Park, Mich.

Clark, Bruce E., engineer, Chrysler Corp., Highland Park, Mich.

Colby, Joseph M., Lt.-Col., U. S. Army, chief, development branch, Tank-Automotive Center, Detroit.

Cole, Edward N., project engineer, Cadillac Motor Car Division, General Motors Corp., Detroit.

Dietrich, Howard H., experimental engineer, Chrysler Corp., Detroit.

Dixon, Howard F., chief engineer, Federal-Mogul Corp., Detroit.

Dodt, Elmer C., chief engineer, Chrysler Tank Arsenal, Chrysler Corp., Detroit.

Even, Arthur D., automotive engineer, U. S. Army, War Department, Tank-Automotive Center, Detroit.

Greenbury, Lawrence B., president, Arrowsmith Tool & Die, Inc., Royal Oak, Mich.

Hamilton, Harry G., sales engineer, New Departure Division, General Motors Corp., Detroit.

Hamilton, Robert C., junior mechanical engineer, U. S. Army Air Corps, Wright Field, Dayton, Ohio. Mail: 616 Puritan Road, Birmingham, Mich.

Henderson, Basil Balfour, chief designer, Parnall Aircraft, Ltd., Surrey, England. Mail: Norge Division, Borg-Warner Corp., Detroit.

Johnson, Axel L., designer, Detroit Diesel Engine Division, General Motors Corp., Detroit.

Kany, John A., automatic cannon engineer, Chrysler Corp., Detroit.

Koeppen, Robert L., service engineer, Timken-Detroit Axle Co., Detroit.

Marvicsin, Mitchell, draftsman, Chevrolet Gear & Axle Division, General Motors Corp., Detroit.

Maude, Russell H., district manager, service engineer, Shakeproof, Inc., division of Illinois Tool Works, Detroit.

McDonald, Arthur L., field engineer, U. S. Rubber Co., Detroit.

Miller, Don E., designer, Detroit Diesel Engine Division, General Motors Corp., Detroit.

Neef, F. E., Jr., Lt., U. S. Army, War Department, Tank-Automotive Center, Detroit.

Obenauer, Davison, field engineer, Lord Mfg. Co., Erie, Pa. Mail: 7310 Woodward Ave., Detroit.

Olsen, Victor A., general manager, Detroit Transmission Division, General Motors Corp., Detroit.

Parker, Glenn H., tank project engineer, Chrysler Corp., Detroit.

Ream, Frank E., Lt., U. S. Army, Ordnance Department, Tank-Automotive Center, Detroit.

Ricks, Bernard Elijah, experimental engineer, Thompson Products, Inc., Detroit.

Rogowski, Michael, draftsman, Plymouth Division, Chrysler Corp., Detroit.

Ruese, Daniel J., tool design checker, Pioneer Engineering & Mfg. Co., Detroit.

Schwamb, Ferd J., ordnance engineer, U. S. Army, Tank-Automotive Center, Detroit.

Simons, H. Charles, leading draftsman, Chrysler Corp., Detroit.

Steere, Robert W., Jr., engineer, Plymouth Division, Chrysler Corp., Detroit.

Swank, Wallace B., sales engineer, Wally B. Swank, Detroit.

Wade, Augustus S., district manager, Detroit area, Weatherhead Co., Detroit.

White, Charles S., research engineer, Micromatic Hone Corp., Detroit.

White, Glen Lewis, experimental engineer, Monroe Auto Equipment Co., Monroe, Mich.

Young, R. Keith, ordnance engineer, U. S. Army, Tank-Automotive Center, Detroit.

Dayton Section

Wood, Walter A., Jr., junior test engineer, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Lockland, Ohio.

Indiana Section

Cost, William A., designing engineer, Marmon-Herrington Co., Inc., Indianapolis.

Crooks, Claud R., vice-president, Honan-Crane Corp., Lebanon, Ind.

Flesch, Louis P., assistant chief metallurgist, Propeller Division, Curtiss-Wright Corp., Indianapolis.

Harlan, Avery S., chief engineer, Honan-Crane Corp., Lebanon, Ind.

Honan, Paul R., treasurer, manager, Honan-Crane Corp., Lebanon, Ind.

Mitchell, Robert W., assistant sales manager, Honan-Crane Corp., Lebanon, Ind.

Metropolitan Section

Bush, W. H., service representative, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Paterson, N. J.

Duboc, Raymond Emile, vice-president and production manager, Matam Corp., Brooklyn, N. Y.

DuBois, George B., project engineer, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Paterson, N. J.

Gordon, Myron B., vice-president and general manager, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Paterson, N. J.

Hartman, Arthur C., Jr., liaison engineer, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Paterson, N. J.

Heil, Daniel, Jr., district manager, Federal-Mogul Corp., New York City.

Jewell, Robert Coddington, Com., U. S. Coast Guard. Mail: 41 W. Elm St., Greenwich, Conn.

Momo, Alfred, shop superintendent, J. S. Inskip, Inc., New York City.

Post, Everts C., national account salesman, Sterling Motors Corp., Long Island City, N. Y.

Schenke, Kurtiss P., engineering manager, Application Co., New York City.

Smith, Ernest G., factory representative, Bendix-Westinghouse Automotive Air Brake Co., Elyria, Ohio. Mail: 535 W. 35th St., New York City.

Stanton, Wallace M., engineering assistant to general manager, Ingersoll-Rand Co., Phillipsburg, N. J.

Winkleblack, R. K., junior engineer, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Paterson, N. J.

Winning, W. Carl, technical adviser, Standard Oil Co. of N. J., New York City.

Wittko, Joseph N., aeronautical engineer, Grumman Aircraft Engineering Corp., Bethpage, L. I., N. Y.

Milwaukee Section

Haislmaier, George J., sales manager, Young Radiator Co., Racine, Wis.

Mohawk-Hudson Group

Anthony, Lester, general manager, Albany Transit Co., Inc., Albany, N. Y.

New England Section

Mosbacher, Karl J., Jr., application engineer, General Electric Co., Lynn, Mass.

Palmer, Mark Augustus, Jr., carburetor repairman, Pratt & Whitney Aircraft, division of United Aircraft Corp., East Hartford, Conn. Mail: Main Street, Graniteville, Mass.

Northern California Section

Byll, Alan John, engineer-calculator, Atlas Imperial Diesel Engine Co., Oakland, Calif.

Hirschfelder, John, assistant chief engineer, Enterprise Engine & Foundry Co., San Francisco.

Koster, Alvin John, State of California, Department of Public Works, Division of Highways, Sacramento, Calif.

Northwest Section

Anderson, Walter, general foreman, U. S. Engineers Division, Seattle, Wash.

Barnes, Erle E., assistant to superintendent of maintenance, Boeing Aircraft Co., Seattle, Wash.

Barnes, Jean D., superintendent of experiment, Petroleum Transport Co., Seattle, Wash.

Johnson, Frank Gustav, squad leader, Boeing Aircraft Co., Seattle, Wash.

Peoria Group

Coker, Morton M., layout draftsman and checker, Caterpillar Tractor Co., Peoria.

Comer, William Harold, checker, Caterpillar Tractor Co., Peoria.

Philadelphia Section

Beatty, John L., sales engineer, Briggs Clarifier Co., Washington, D. C. Mail: 632 Race St., Philadelphia.

Gray, Robert S., supervisor, manufacturers' sales, Electric Storage Battery Co., Philadelphia.

Holbrooke, Marshall Dudley, service representative, United Aircraft Service Corp., East Hartford, Conn. Mail: Narberth, Pa.

Jeheber, R. A., diesel engineer, Mack Mfg. Corp., Allentown, Pa.

Meister, E. A., general manager, Radbill Oil Co., Philadelphia.

Tully, Vincent J., fleet maintenance manager, J. Gibson McIlvain Co., Philadelphia.

Turner, Filo Harris, Ensign, USN, Naval Aircraft Factory, Philadelphia.

Pittsburgh Section

Oswald, Louis W., manager, bar and semi-finished materials bureau, Carnegie-Illinois Steel Corp., Pittsburgh.

Secoy, Paul G., branch manager, Fruehauf Trailer Co., Pittsburgh.

St. Louis Section

Seesock, Frank L., weight engineer, McDonnell Aircraft Corp., St. Louis, Mo.

Watkins, John A., 2nd Lt., U. S. Army, Camp Wolters, Texas. Mail: 314 Clara Ave., St. Louis, Mo.

Southern California Section

Allingham, W. B., superintendent of maintenance, System Freight Service, Los Angeles.

Boggess, Jack C., Capt., U. S. Army, APO No. 7, Camp Luis Obispo, San Luis Obispo, Calif.

Carson, Harry, Jr., Lt., U. S. Army, Camp San Luis Obispo, San Luis Obispo, Calif.

Colgrove, Thurman H., Globe Bearing Co., Ltd., Los Angeles.

Crooks, Duncan C., instructor, Bonita High School, La Verne, Calif.

Davis, Harold McDonald, vice-president, Aero-Coupling Corp., Burbank, Calif.

D'Amico, Emilio A., supervisor, Douglas Aircraft Co., Inc., El Segundo, Calif.

Dennis, Robert L., production engineer, Northrop Aircraft, Inc., Hawthorne, Calif.

Foushee, Clarence L., Jr., assistant foreman, Ryan Aeronautical Co., San Diego, Calif.

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turn to page 70

NEW MEMBERS Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Nov. 15, 1942, and Dec. 15, 1942.
The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

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